Industry and Power

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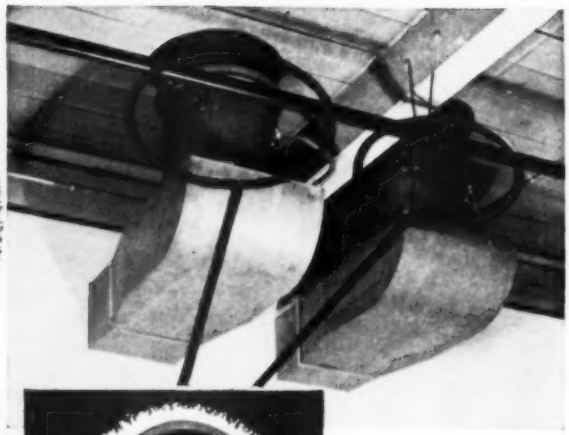
— for engineered plant services

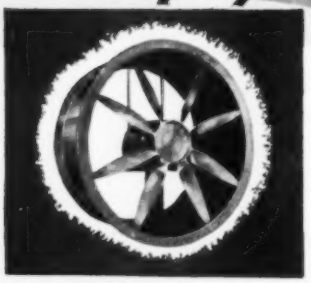
in Park Ridge, N. J.

Mittag & Volger, Inc.

RELIES

on HARTZELL fans and blowers





DUCT FAN

Sizes from 12" to 60". Belt or direct drive. Single propeller, two-propeller and multi-blades styles. As easy to install as a section of duct.

There's a Hartzell fan or blower to meet every industrial air-moving need. At the Park Ridge, N. J., plant of Mittag & Volger, Inc., manufacturers of carbon paper and inked ribbons, more than 20 different Hartzell units have proved that when air-moving problems are getting you down it pays to rely on Hartzell.

Shown at right above are the two Hartzell direct-drive duct fans which are used for rest room exhaust. The lower photo shows the three Hartzell 28" Lo-Noise Fans which provide *quiet*, efficient ventilation for the mill room. Roof ventilators and unit heaters are also counted among the Hartzell equipment giving dependable service at Mittag & Volger.

The right equipment, properly used, will beat even the toughest air-movement problem. The right equipment? Hartzell has been a leader in the industry for more than a quarter of a century because Hartzell engineering and quality workmanship are concentrated on *one* objective—more efficient, more economical air-moving equipment for *industry*. The right installation? Your nearby Hartzell field office puts the engineering "know-how" of the whole Hartzell organization right in your back yard.

Send us the details of your air-moving problem today. (And send for Catalog B-10, with details on the new line of Hartzell centrifugal blowers.)

The installations shown in this advertisement were handled by the Hartzell field office at 1440 Broadway, New York 18, N. Y.; telephone PEnnsylvania 6-0277.

LO-NOISE FAN

For installations where noise level must be kept low; special airfoil blade gives full efficiency with slow tip speed. Sizes from 24" to 60".

HARTZELL

propeller fan co.

Div. of Castle Hills Corp.

Dept. B

PIQUA, OHIO

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

Name _____

Company _____

Street & Number _____

City & State _____

If student, check here for special information ☐

WITH HOSE, TOO

It pays to order from your Goodyear Distributor

STANDARD HOSE REPLACES SPECIAL CONSTRUCTION

This company had been using specially-built, heavy, plied-up type hose requiring special construction at a high price. The Goodyear Distributor called in the G.T.M.—Goodyear Technical Man—found standard ORTAC hose with oil-resistant cover could do the job at a fraction of the cost.

PREMATURE HOSE FAILURE ENDED

A sand and gravel company was troubled with premature failure of water and sand discharge hose, caused by slight suction set up when pumps were started. The Goodyear Distributor and the G.T.M. recommended DIVERSIPIPE—which has served over two years and is still going strong.

Here's why it pays to order from your local Goodyear industrial rubber products distributor.

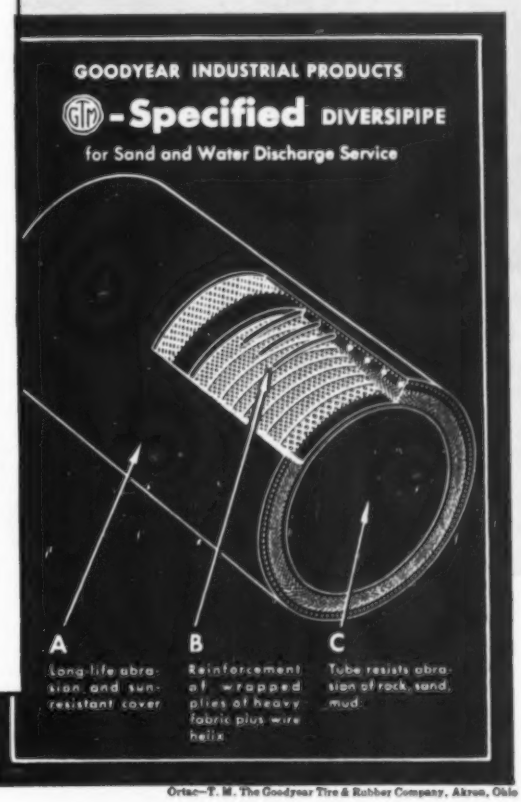
Replacement orders filled when you need them from convenient, local stocks.

One order, *one* bill, *one* central responsibility for all your Industrial Products requirements.

You save on valuable stockroom space, because your local distributor maintains a full stock of the items he knows you need.

Double assurance of satisfaction because the distributor and Goodyear stand behind the products he sells you.

Goodyear, Industrial Products Div.,
Akron 16, Ohio


GOODYEAR INDUSTRIAL PRODUCTS
GTM-Specified DIVERSIPIPE
for Sand and Water Discharge Service
A
Long-life abrasion and sun-resistant cover
B
Reinforcement of wrapped plies of heavy fabric plus wire helix
C
Tube resists abrasion of rock, sand, mud

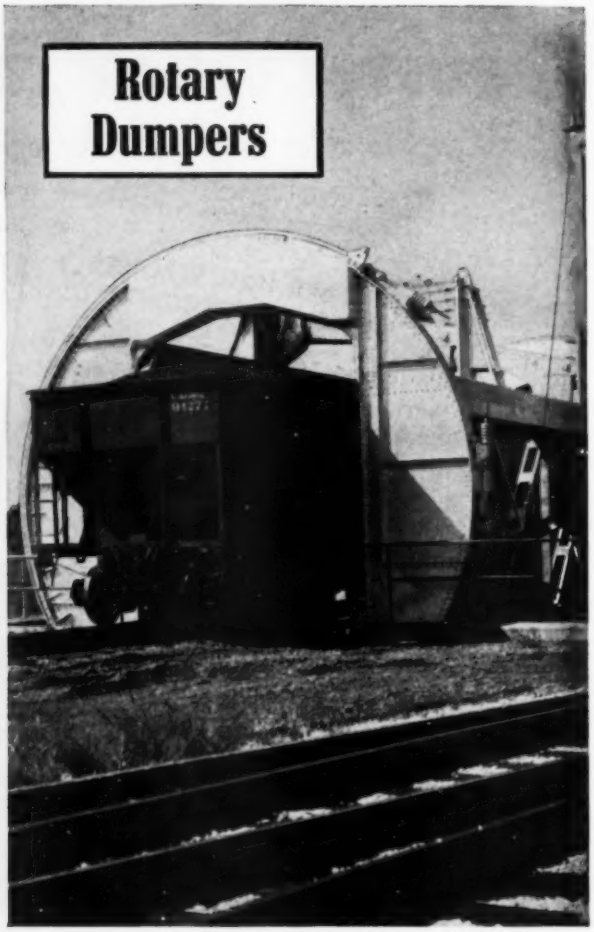
Ortac—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

We think you'll like
THE GOODYEAR TELEVISION PLAYHOUSE
every other Sunday—NBC TV Network

GOODYEAR

THE GREATEST NAME IN RUBBER

EASIER ON CARS with minimum noise level . . . thanks to exclusive low-frequency vibration. The Link-Belt Car Shaker helps hopper cars empty themselves. Even hard-packed loads come "broom clean" in a matter of minutes. Especially good for damp, sticky materials. Write for Book 2345.



BOTTOMS UP . . . empties 90-ton car every 60 seconds or less (including return to upright position) by simply turning car upside down. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

Railroad cars come clean . . . in as little as 60 seconds or less!

For fast, safe, push-button car unloading . . . at substantial savings — choose Link-Belt equipment

IF you empty a few gondola cars a day—or several thousand a week, Link-Belt makes the right railroad car unloader for your particular requirements. Only Link-Belt builds both types—the automatic Rotary Car Dumper for large users . . . the low-frequency Car Shaker for smaller operations.

Both are precision engineered to reduce unloading hazards, minimize injury possibilities, cut costly demurrage charges.

Yes, if your operations require rapid railroad car unloading of any bulk material, it will pay you to call your nearest Link-Belt representative. He'll give you an unbiased recommendation for the right type of equipment for your needs.

LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13.203

Industry and Power

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LUBE and FUEL OIL PURIFICATION . . .

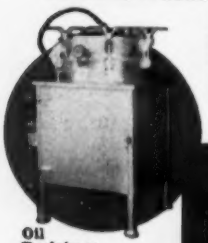
GET RID OF DIRTY OIL . . .
GET LOWER OPERATING COSTS
LONGER EQUIPMENT LIFE

HILCO oil purification means complete oil purification! With a HILCO you get removal of sludge, acids, carbon, water and fuel dilution economically and efficiently. HILCO operation is continuous, all-electric and automatic.

Clean oil at all times reduces down time, increases production and HILCO units pay for themselves in savings.

HILCO offers a wide range of oil purification units . . . one to meet your needs. Write us about your equipment . . . and get recommendations at no obligation.

● *THERE'S A* **HILCO** *FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM*

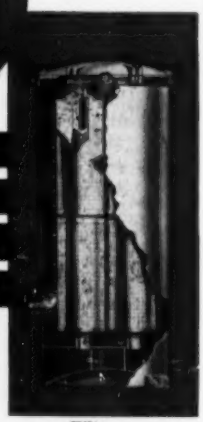


HILCO has 25 years experience in oil purification. Let this experience work for you.

Oil Reclaimer

PURIFIERS
FILTERS
RECLAIMERS
CONDITIONERS

A complete range of sizes and systems for oil purification.



Filter

★ *WRITE FOR* **FREE** *LITERATURE NO OBLIGATION ON YOUR PART*

THE HILLIARD CORPORATION
105 W. FOURTH ST.
ELMIRA, N. Y.

IN CANADA — UPTON - BRADEEN - JAMES, Ltd.
990 Bay St., Toronto, 3464 Park Ave., Montreal

acorns

. . . recently announced . . . worth watching

Shooting Aerosols

● To improve the understanding of aerosols — airborne solid or liquid particles — a camera has been developed which photographs the particles while they are suspended in mid-air. (Formerly, particles were trapped and viewed on slides.) With the new gadget, repetitive exposures record on film the behavior of a particle over an interval of time while in suspension. The camera photographs a volume less than 5/100,000 cu in. on each exposure, giving scientists a really close look at the air around us and the things in it.

Coming Magnets

● Magnets are coming which will be made of barium oxide and iron oxide, eliminating many critical materials. The new magnets have characteristics which approach the properties of alnico. They are expected to be useful in motors and generators in addition to other applications.

Burning Questions

● What goes on inside engine cylinders constantly intrigues combustion engineers—and they forever seek new ways to peek in on the burning process. Now they have come up with a fast-acting valve which permits extraction of combustion gases from cylinders over very short intervals. By analysis of these samples, detailed data are obtained showing the exact proportions of reactants and products present during various stages of the cycle. The sampling valve allows removal of gases over as short a period as 0.2 to 0.3 millisecond; the sample is then examined using mass spectrometer techniques. Recent work indicates that acetylene is an important intermediate in the hot-flame combustion of hydrocarbons.

Purity vs Impurity

● While it is generally conceded that purity is a good thing, intensive studies reveal important roles played by traces of impurities properly placed in many materials. Only recently has the full significance of impurities begun to be understood in luminescent and photosensitive materials, among others. With the new-found understanding of impurities, metallurgists are learning new ways with alloys; the critical role of impurities on crystalline structures has been found vital in determining the strength, stamina, and ductility of metals.

Listening In

● A report has just been released concerning the use of ultrasonics as an inspection tool for foundry products. The device used determines thicknesses with high accuracy and makes visible porous areas and core shifts.

Cooling Bearings

● A large scale project is underway to study the characteristics of freight car journal bearings under controlled laboratory conditions. From this work, it is expected that the cooling action around the bearing will be better understood and then improved. The effects of different oils and wick materials will be looked into.

Ion Exchanging with Cotton

● Researchers have found that by replacing hydroxl ions in the cotton cellulose molecule with certain reactive chemical groups, the cotton shows ion exchange capacities. Actual use of this discovery will probably mean new and unique physical forms of ion exchangers. Ease in handling and re-use possibilities make them attractive for certain applications.

Analyzing Lubricants

● A speedy, accurate spectrographic method of analyzing lubricating oils for metallic contaminants has been announced. Routine analysis of oils becomes possible because of the speed and economy of the operation.

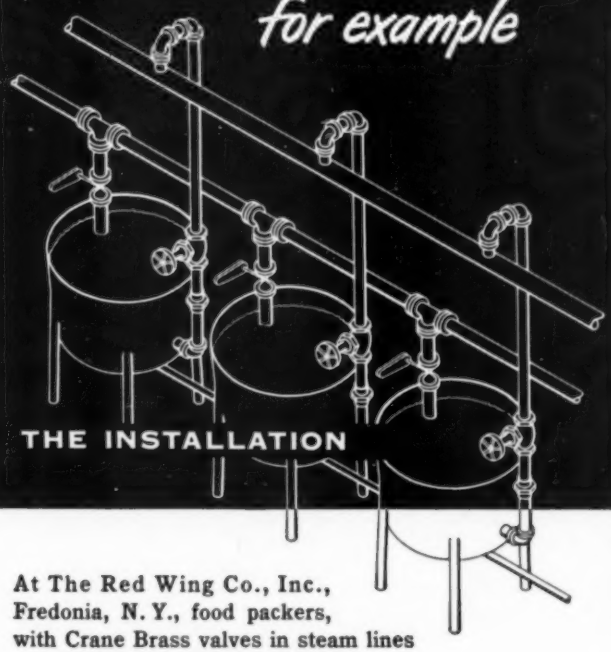
Watch Zirconium

● A big future is predicted for zirconium as a corrosion-resistant material for the chemical industry, competing with titanium. Zirconium is especially effective in withstanding attack by hydrochloric acid. As if to anticipate the demand, another group reports a new process for the production of zirconium; they use arc dissociation of halides.

Blowing Bubbles

● The fundamental aspects of bubble formation within the body of a liquid are being studied for a better understanding of steam formation in water by the volume boiling method. This work stems from the nature of certain atomic reactors which are being considered in the effort to harness atomic energy for power.

How Better Quality Valves Pay Off ...on Steam Throttling, for example



THE INSTALLATION

At The Red Wing Co., Inc., Fredonia, N. Y., food packers, with Crane Brass valves in steam lines to juice heaters and cooking kettles.

VALVE SERVICE RATINGS

SUITABILITY:	None better for throttling
MAINTENANCE COST:	No expense here
SERVICE LIFE:	No sign of wearing out after 4 years
OPERATING RESULTS:	Precise control of steam to cookers
PRICE:	Bigger value than any other valve used
AVAILABILITY:	Regular Crane Catalog Item - No. 212P

THE CASE HISTORY

At least once a week there was valve trouble in the cooking room. Leaky valves . . . disc and seat cut out . . . steam to kettles out of control.

New valves made little difference; none could stand the severe steam throttling. Not until Crane plug-type disc valves were installed.

Immediately the valve trouble stopped as did the cooking interruptions. Not even the plant operator believed it possible. In use now more than 4 years with no maintenance cost, the Crane No. 212P valves are still in like-new condition. They show no erosion, no leakage; and they operate freely.

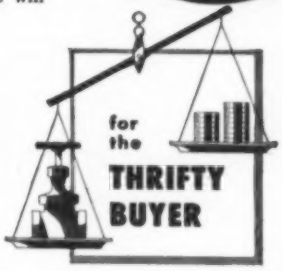
THE VALVE

Designed expressly for severe throttling service, these Crane brass valves have plug type disc and seat of Crane Nitri-Hard stainless steel. Seating surfaces are practically impregnable to damage by cutting, erosion, etc. Disc taper permits close flow regulation. For any kind of throttling look into these valves for 150, 200, and 300-pound steam services. Your Crane Catalog or your Crane Representative will give you all facts.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

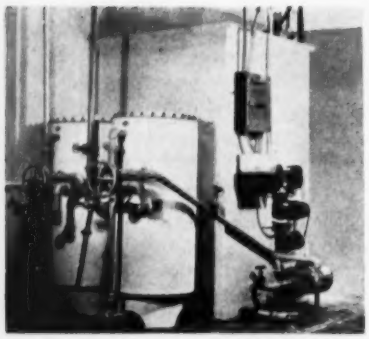
CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas



VALVES • FITTINGS • PIPE • PLUMBING • HEATING

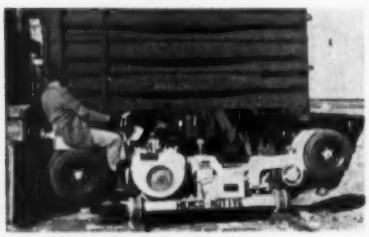
new equipment

. . . new developments



Package water conditioner provides versatility

H10 Efficiency, versatility, and simplicity are advantages of a completely integrated package water conditioning plant developed by The Permutit Co. Without alterations, it can be used to remove turbidity, color, and organic material from water supplies, to chlorinate, to remove bad tastes and odors, to remove iron and manganese, to neutralize, to soften, and to de-alkalize. Units, ranging from 500 to 3300 gph, consist of a precipitator with a built in clearwell, a proportioning chemical feeder control, a coagulant feeder tank, a lime or soda ash and hypochlorite feeder tank, an inlet float control valve, filter units, purifier units, and a service pump.

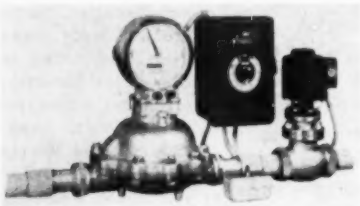


Unit simplifies switching and spotting railroad cars

H11 Due to its combination rail and ground operation, a roadable switch engine developed by Hemco Manufacturing, Inc., simplifies the problems of switching and spotting railroad cars. Known as HemcO-Motive, it incorporates a hydraulic cylinder to transfer the railroad car's weight onto itself, thus providing necessary traction. It develops a draw bar pull of 7400 lb, which under average conditions is sufficient to propel three fully loaded cars, or six to eight empties. It moves cars at a speed of 150 fpm, and moves at 8 to 10 mph on the rubber tires.

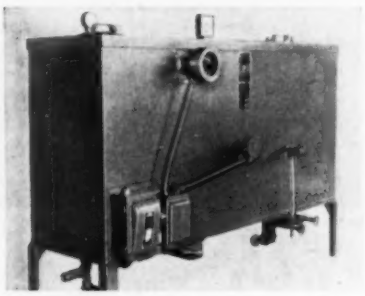
Transformer components for switchgear equipment

H12 Transformers in sizes from 100 to 3000 kva for voltages to 15,000 v are being manufactured by Marcus Transformer Co. for use with switchboards and switchgear. Cores and coils are constructed with Class B and C heat-proof insulation, capable of withstanding severest operating conditions. The insulation consists of Johns-Manville Quinterra and Quinglass, and du-Pont's Mylar Polyester film. Provisions are made for forced air cooling.



Automatic system provides repetitive liquid measurement

H13 Buffalo Meter Co. has developed an automatic, repetitive, push-button system for liquid measurement that is neither expensive or overly complicated. Known as Electrivolume Metering, it incorporates an Electricontact meter designed specifically for the liquid being measured. An electric impulse, generated upon delivery of each unit of liquid, is transmitted to a counter which accumulates impulses up to the predetermined number. Upon reaching this point, a solenoid valve in the liquid line closes, and the counter returns to zero for the next run. Operation is discussed in available literature.



Separator increases vacuum pump efficiency

H14 To provide increased effectiveness in the removal of moisture from vacuum pump oils, Honan-Crane Corp. has redesigned its Houdaille Dri-Pure water-oil separator. By effectively removing moisture, the unit reduces pump down-time and increases overall operating efficiency. The unit consists of two filtering compartments using cellulose fibre and fuller's earth, plus a thermostatically controlled heating and settling tank. Construction, permitting replacement of filter cartridges, is described in a bulletin.

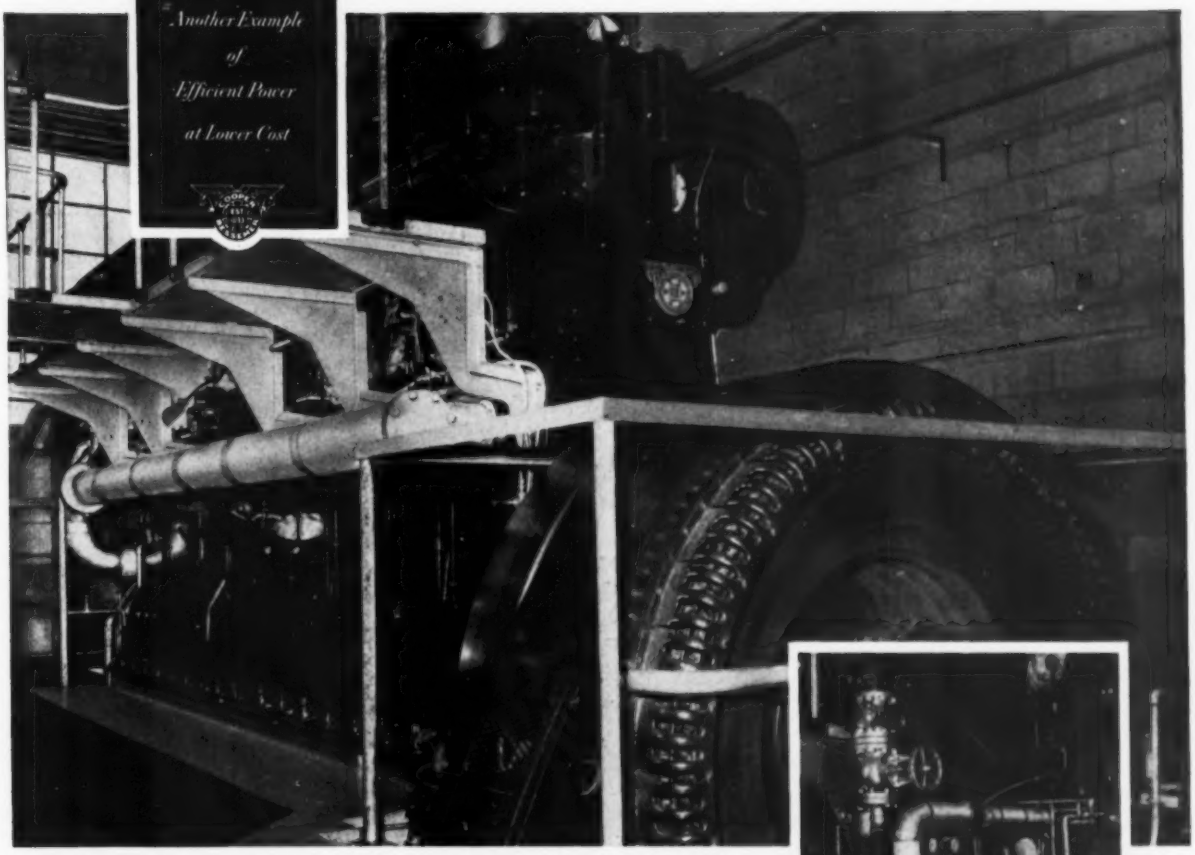
Right-angle unit provides stepless speed adjustment

H15 U. S. Electrical Motors, Inc. has combined its fractional horsepower, variable speed motors with right-angle gear reducers to provide a compact, right-angle hook-up for applications requiring low, variable speeds. This Varidrive-Syncrogear motor, called type VA-GW, is available in ¼, ⅓, ½, and ¾ hp with speed variations up to 10 to 1. It is particularly suited to such applica-

(Continued on page 12)

NOTE — Each new product item has a key number for your convenience in asking for additional, detailed information. Insert this number on return post card on page 99.

Another Example of Efficient Power at Lower Cost



Latest of three Cooper-Bessemer LS-8 diesels in International Latex plant, this supercharged 1700 hp unit provides 40% thermal efficiency. End view at right shows piping setup for jacket water heat recovery contributing to 80% over-all thermal efficiency.

How they stretch dollars at International Latex

● Here's a diesel plant that is turning in amazing results—*80% over-all thermal efficiency!* The engine is a Cooper-Bessemer supercharged LS-8, installed in the International Latex plant at Playtex Park, Dover, Delaware.

To start with, this modern LS diesel exceeds 40% thermal efficiency — performance rarely equalled! On top of that, an ingenious jacket water heat recovery system captures for processing use another 40% of the total heat input.

In all there are three Cooper-Bessemer LS-8's in this International Latex plant—the supercharged unit shown above and two previously installed atmospheric LS-8's. Later on these original LS-8's can be easily converted to supercharged operation to boost their output and to match the remarkable efficiency of the new unit.

Whatever your power needs may be, check with Cooper-Bessemer. Find out how much you stand to save by the best to be had in efficiency and long, trouble-free engine life.

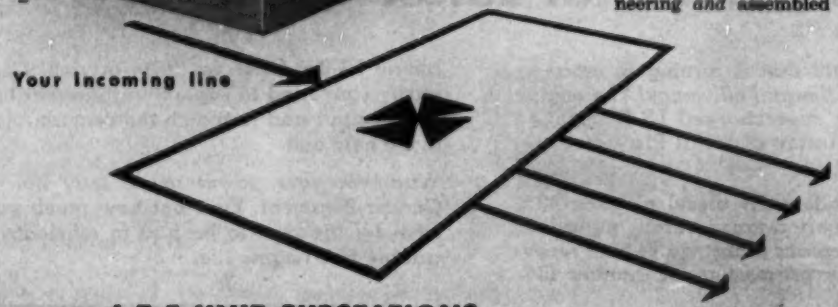
The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

COMPLETE ENGINEERING *costs less!*

You provide the requirements. I-T-E provides the complete engineering *and* assembled equipment.



I-T-E UNIT SUBSTATIONS

are available in all required ratings, indoor or outdoor, for every service condition. Substations include primary air circuit breakers or interrupter switches, transformers (oil-filled, askarel-filled, air-cooled, or nitrogen-sealed), and secondary air switchgear.

I-T-E Unit Substations for modern plant distribution

Modern plants require the utmost in power distribution efficiency, reliable circuit protection, service continuity, safety, and economy.

Unit Substations—integrated units of stepdown transformers and protective switchgear for location at load centers—have been an I-T-E specialty for many years.

Over-all responsibility

From the incoming lines to the outgoing circuits, I-T-E supplies all the equipment you need—completely coordinated as a package. Furthermore, I-T-E assumes full responsibility—from initial planning, through manufacture, to shipment. Factory-assembled and -tested, *complete* unit substations are delivered ready for installation.

Quality throughout

I-T-E's experienced staff of switchgear engineers assures you professional competence in the selection and application of all components to fit each job. The proved quality of I-T-E products is your guarantee of uniform, outstanding performance, long life, and over-all economy.

See how much I-T-E COORDINATED PLANNING can save you!

There is an I-T-E Application Engineer near you. He will assist you with your specific requirements—and show you how you can save with *complete* I-T-E engineering. Give him a call. Look in the classified section of your telephone directory under "Electrical Equipment."

I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

I-T-E

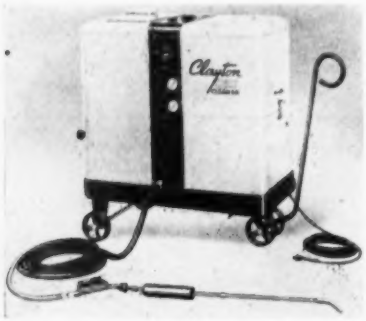
UNIT SUBSTATIONS

for every application

new equipment

(Continued from page 8)

tions as conveyors since most worm-gear ratios are self-locking when not in use. Because the variable speed transmission is of the V-belt type, speed changes may be effected while the motor is in operation.



Steam cleaning machine provides high capacity

H16 Clayton Manufacturing Co. has designed a low-cost, high-capacity steam cleaning machine to handle large volumes of work with utmost speed and efficiency. This self-contained unit, known as the model LH Clayton Kerrick-Steam Cleaner, is capable of discharging 150 gph of balanced cleaning solution at variable pressures from 30 psi to 100 psi. Full working pressure is attained in 2 min from a cold start. Oil and gas fired, electrically driven, gasoline engine driven, as well as portable, stationary, and trailer models, are available. Remote nozzle control is optional. Construction is described in a bulletin.

Device protects chain drives

H18 To protect chain drives of all types from overload in event of excessive tension on the drive leg, Lamson Corp. has developed a device incorporating an eccentrically located idler sprocket counterbalanced by a weight-loaded arm. The counterbalance is adjustable so that a limit switch will operate at any chain tension up to 1000 lb. The unit, which is adaptable to chain sizes from ½ to 1¼ in., uses 115 v a-c supply.

TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 99. Your requests will be handled promptly.

Process permits color coding of photocopies

H19 To enable businesses to color-code photocopies for fast visual separation, American Photocopy Equipment Co. has developed a process that will make copies in any color, regardless of the color of the original. The process is adapted to the company's Apeco Systematic Auto-Stat office photocopy machine. With this machine, even an inexperienced operator can produce a minimum of 100 copies per hr in any color. The unit, for producing copies up to 11 in. wide and in any length, prints, processes, and dries automatically. Literature is available.

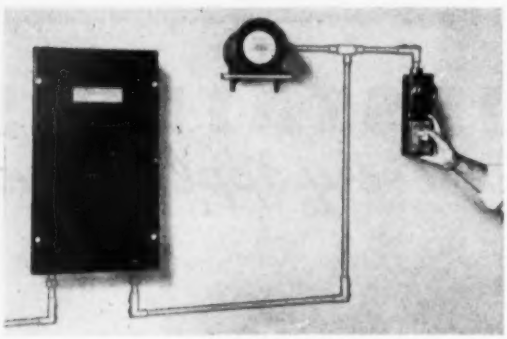
Impact wrench increases working speed

H20 Snap-On Tools Corp. has designed a ½ in. square drive impact wrench for use with a variety of sockets and attachments. In addition to its use as a wrench, it can be used for driving gear pullers, stud removers, screw driver bits, hole saws, structural reamers, and steel, wood, or mortar bits. After a certain torque is reached, the rotary action of the motor changes to sharp, powerful blows at the drive spindle. The blows become

(Continued on page 16)

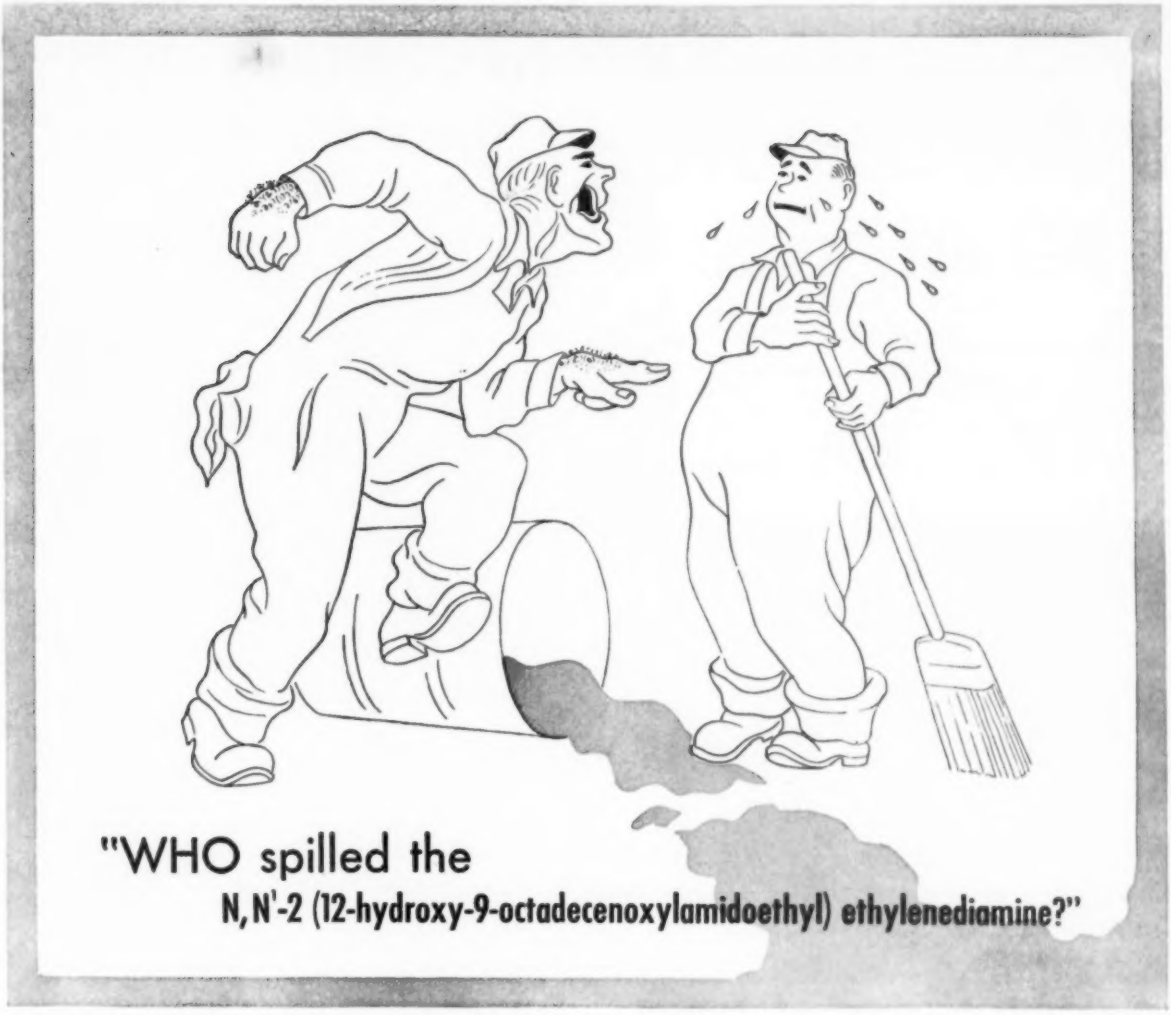
Communication system employs existing electrical circuits

H17 To provide two-way voice communication between base stations and mobile units such as cranes, ore bridges, yard locomotives, and boat unloaders, Mine Safety Appliances Co. has developed the Telecrane FM Carrier Communication System. It is said to aid in co-ordinating operations, thus speeding production, promoting safety, and reducing delays in materials handling. It provides clear, direct voice communication, audible above the noise level of



plant operation, and it is free from transmission noise and interference.

No new or additional wiring connections are needed, since the system employs existing electrical circuits for transmitting carrier waves. A coupling capacitor joins the carrier frequency to any a-c or d-c power line. For isolated locations, circuits operating on storage batteries also are available. Construction and operation is discussed in a 4-page folder.



LET'S put it this way: WHO SPILLED THE NALCO ANTIFOAM? Either way . . . N, N¹-2 (12-hydroxy-9-octadecenoxylamidoethyl) ethylenediamine, or Nalco Antifoam . . . this foam control material is powerfully effective. It is one of several Nalco antifoams that are widely used, not only in boilers, but wherever foaming liquids are a problem.

Nowadays the language of the water treating industry could be full of confusing technical terms . . . like this chemical description of a Nalco antifoam. Translation to common, understandable terms is one of the jobs of your Nalco Representative. You can count on him for an honest appraisal of your problem and a simple, unconfusing recommendation for its solution.

GET YOUR COPY OF
"This is Nalco"

This picture story of Nalco will acquaint you with the research and production facilities available to solve your water treating problems. Write for your free copy today.

NATIONAL ALUMINATE CORPORATION
6218 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE *Nalco*®
SYSTEM . . . Serving Industry through Practical Applied Science

What has caused this tremendous swing to Riley Traveling Grate Spreader Stokers?

As more and more Riley Traveling Grate Spreader Stokers have been placed in operation Riley Spreader Stokers are being selected by greater and greater numbers of the country's leading public utility and industrial plants—to such an extent that Riley sales in 1952 were more than four times 1950 sales and fifty per cent greater than in 1951 though total boiler and stoker industry sales were appreciably lower.

We believe the fundamental reason for this tremendous swing to Riley is that news of the excellent results and satisfactory performance of Riley Spreader Stokers has traveled rapidly from plant to plant. Such satisfactory performance is largely due to design characteristics and the vast experience of Riley in the stoker field.

THE GRATE SURFACE The grate surface is made up of small clips, two inches wide by six inch pitch, mounted on structural T bars. The use of small grate clips eliminates warping and cracking and assures low maintenance and long life by providing adequate cooling. Clips are of nickel-chrome alloy to minimize growth. A level grate surface and uniform air distribution results.

THE FEEDER-DISTRIBUTOR The feeder is designed to give uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The overthrowing distributor gives uniform longitudinal and lateral distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing.

TRADE MARK Rx REGISTERED

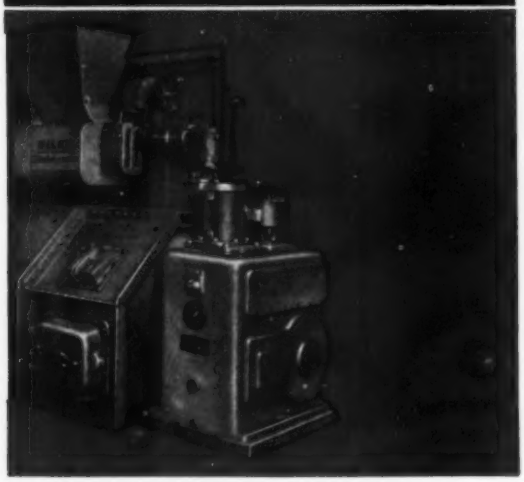
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

Comparative Sales of Riley Traveling Grate Spreader Stoker for 1950 - 1951 - 1952



THE GRATE DRIVE The Riley grate drive is a hydraulically driven ratchet drive, completely enclosed and automatically lubricated. This simple rugged drive operates with practically no maintenance and is not susceptible to damage in case of grate obstruction. No sprockets, chains or speed reducers are required.

BACKED BY OVER 50 YEARS OF EXPERIENCE
There are over 50 years of stoker designing and manufacturing experience back of the Riley Traveling Grate Spreader Stoker, dating back to the two first successful makes of stoker—the Murphy Furnace and the Jones Underfeed Stoker. Riley has been manufacturing traveling grate stokers for over 30 years.

We believe it will pay you to visit some installations before purchasing traveling grate spreader stokers.

All of these Companies have ordered Riley Traveling Grate Spreader Stokers

Montana-Dakota Utilities
Mandan, North Dakota

Upper Peninsular Power Co.
Houghton, Michigan

Bendix Aviation Corp.
South Bend, Indiana

Hawaiian Commercial & Sugar Co.
Maui, Hawaii

General Motors Corp.
Saginaw Steering Gear Div.
Saginaw, Michigan

White Pine Copper Co.
White Pine, Michigan

Electrica De Bogota
Bogota, Colombia

Ohio Edison Co.
Youngstown, Ohio

City of Painesville
Painesville, Ohio

Carbide & Carbon Chemical Company
Whiting, Indiana

Ohio Edison Company
Springfield, Ohio—two orders

Iowa-Illinois Gas & Electric Company
Iowa City, Iowa

Celanese Corp. of America
Hopewell, Virginia

Cliffs Power & Light Company
Ishpeming, Michigan

Iowa Public Service Company
Carroll, Iowa

Kennecott Copper Company
McGill, Nevada

General Electric Company
Richland, Washington

Garlock Packing Company
Palmyra, New York

Swift & Company
Baltimore, Maryland

E. I. DuPont de Nemours & Co.
Savannah River Project, South Carolina

Kaiser-Frazer Company
Willow Run, Michigan

B. F. Goodrich Company
Akron, Ohio

Utah-Idaho Sugar Company
Washington

Armstrong Cork Company
Lancaster, Pennsylvania

Pennsylvania Electric Company
Seward, Pennsylvania—three orders

Ohio Edison Company
Youngstown, Ohio

Ottertail Power Company
Crookston, Minnesota

Champion Paper & Fibre Company
Canton, North Carolina

Central Illinois Light Company
Springfield, Illinois

Monsanto Chemical Company
Springfield, Massachusetts

General Electric Company
Louisville, Kentucky

Gaylord Container Company
Bogalusa, Louisiana

John Deere & Company
Alladin, Iowa

Swift & Company
Charlotte, North Carolina

Brown-Lipe-Chapin Div.
General Motors Company
Elyria, Ohio

U. S. Gypsum Company
Oakfield, New York

Stokely Foods
Indianapolis, Indiana

Catalytic Construction Company
Fernald Project, Ohio

Sangamo Electric Company
Springfield, Ohio

University of Minnesota
Minneapolis, Minnesota

Rochester Municipal Plant
Rochester, Minnesota

City of Napoleon
Napoleon, Ohio

Corn Belt Power Co-op.
Humboldt, Iowa

U. S. Air Force Base
Limestone, Maine

City of Ames
Ames, Iowa

Alabama Electric Co-op.
Andalusa, Alabama

Minnkota Power Cooperative, Inc.
Grand Forks, North Dakota

Spokane Water Works
Spokane, Washington

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

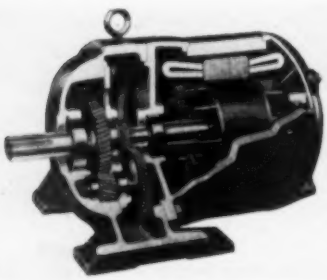
new equipment

(Continued from page 12)

heavier as torque increases to provide greater turning impact for large work. One-hand operation is possible under all working conditions, because torque is not transmitted to the operator. Models are available for 115 or 220 v operation.

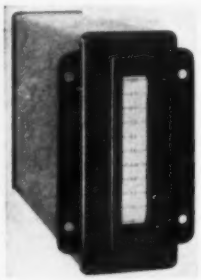
Meter measures free-flowing solids

H21 Measurement of free-flowing solid material such as grain, dry chemicals, flour, and other cereal products is provided by a flow meter developed by Wallace & Tiernan. Known as Massometer, it measures mass flow rate by determining the torque produced in accelerating the flow. Torque is measured by pneumatic force-balance system, and conventional pneumatic receivers indicate, record, and totalize flow in pounds per minute. Maximum capacity is 225 lb per min. A data sheet is available.



Gearmotors feature wide selection

H22 Gearmotors incorporating a wide selection of compact, integral power units with single, double, or triple speed reduction, have been developed by Elliott Co., Crocker-Wheeler Div. Units are available with a-c squirrel-cage or wound rotor, and d-c multispeed motors in open-protected, splashproof, totally-enclosed non-ventilated, totally-enclosed fan-cooled, and explosion-proof closures. Sizes range from 1 to 150 hp for speeds from 780 to 7.5 rpm. A positive oil seal between gears and the high-speed bearing lengthens bearing life by sealing off abrasive matter. A bulletin is available.



Indicator is designed for graphic panels

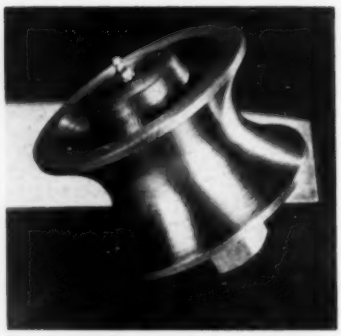
H23 Continuous indication of valve positions or variables such as liquid levels is provided by a ribbon-type indicating receiver designed by The Foxboro Co. for use with graphic panels. The unit receives pneumatic measurements from a transmitter located at the process. Since the indicator scale measures only ¾ by 4¼ in., the instrument fits easily into graphic panel symbols. Single or dual indicating scales are available, and can be adjusted for direct or reverse response to measurement as desired. Alarm contacts are optional.

TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 99. Your requests will be handled promptly.

Oven reduced motor repair time

H24 According to the manufacturer, Michigan Oven Co., insulation roasting ovens for electric motor repair cut stripping time formerly requiring 3 to 5 hr to as little as 15 min. The oven's air-cooling system is designed to provide complete incineration of varnish and other combustible material on motors, distribution transformers, dipping racks, and hooks. Distortion and cracking of motor frames is minimized by temperature uniformity. Fuel automatically shuts off at incinerating temperature, permitting combustibles to carry the process to completion. Literature is available.



Guide protects conveyor belts

H25 Knapp Mills, Inc., reports that it has acquired patent rights for a conveyor belt guide designed to protect belt edges from ripping and tearing even under the most heavy use. The device, developed by a Norwegian, is named a Guidler because it can be used as both a guide and an idler. It has been successfully used in Norway for several years on belts used for transporting ores, rock, coal, and bulk handling in general. When properly installed, the unit presents a revolving hyperbolic face to the belt edge.

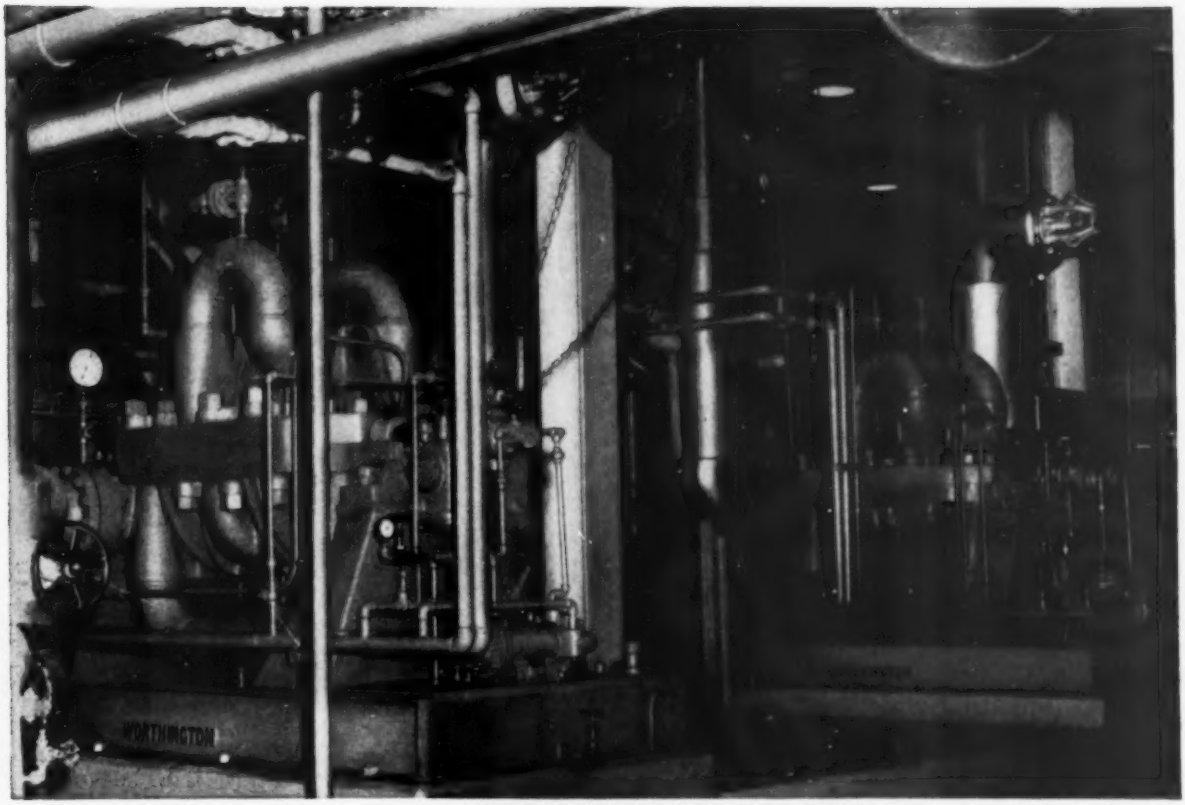
Instruments registers machine operating time

H26 To provide a continuous record of running time for all industrial machines operating on a-c current, Engler Instrument Co. has designed a precision instrument known as the AC Hour Log. It is said to be particularly useful where regular servicing of equipment is based on actual operating time, or for providing downtime records to be used in time studies. A bulletin is available.

Unit locates cable faults

H27 To provide industry with an economical cable fault locator, James G. Biddle Co. has developed the model 4 Transmitter. Although designed primarily for lead covered cables installed in ducts, it may also be used on aerial and buried types. It provides a d-c over-voltage test facility that is particularly suited to cables and electrical apparatus in the lower voltage classes. Maximum proof testing capacity is 15 ma at about .7

(Continued on page 22)



THIRTY WORTHINGTON BOILER FEED PUMPS have been purchased by the Southwestern Public Service Company of Amarillo, Texas. The two boiler feed pumps above, installed at Southwestern's new Plant X, deliver 1165 gpm, at 1125 psi total head.

Worthington helps bring more power to the Southwest

30 Worthington boiler feed pumps installed by Southwestern Public Service since 1945

Plant X, ten miles north of Amherst, Texas, is the newest and largest of the Southwestern Public Service Company's eleven generating stations. Since September, 1945, Southwestern Public Service has been expanding, building new stations to meet the Southwest's increasing power needs.

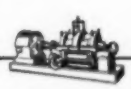
Worthington has played an important part in this expansion. During the past eight years, thirty Worthington boiler feed pumps have gone into Southwestern Public Service power plants. In Plant X alone, Worthington has supplied, in addition to the boiler feed pumps, heater drain pumps, water softeners, sump pumps, air compressors, and the open feed-water heater.

Power engineers everywhere have found that Worthington has kept pace with the increase in capacity and pressure of steam generating units and is prepared to furnish boiler feed pumps for any modern power plant requirements.

We'd like to hear about your own pumping problems. Get in touch with your nearest Worthington district office, or write directly to Worthington Corporation, Centrifugal Pump Division, Section C.3.5, Harrison, N. J.

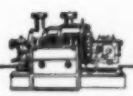
C.3.5

For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.



For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.

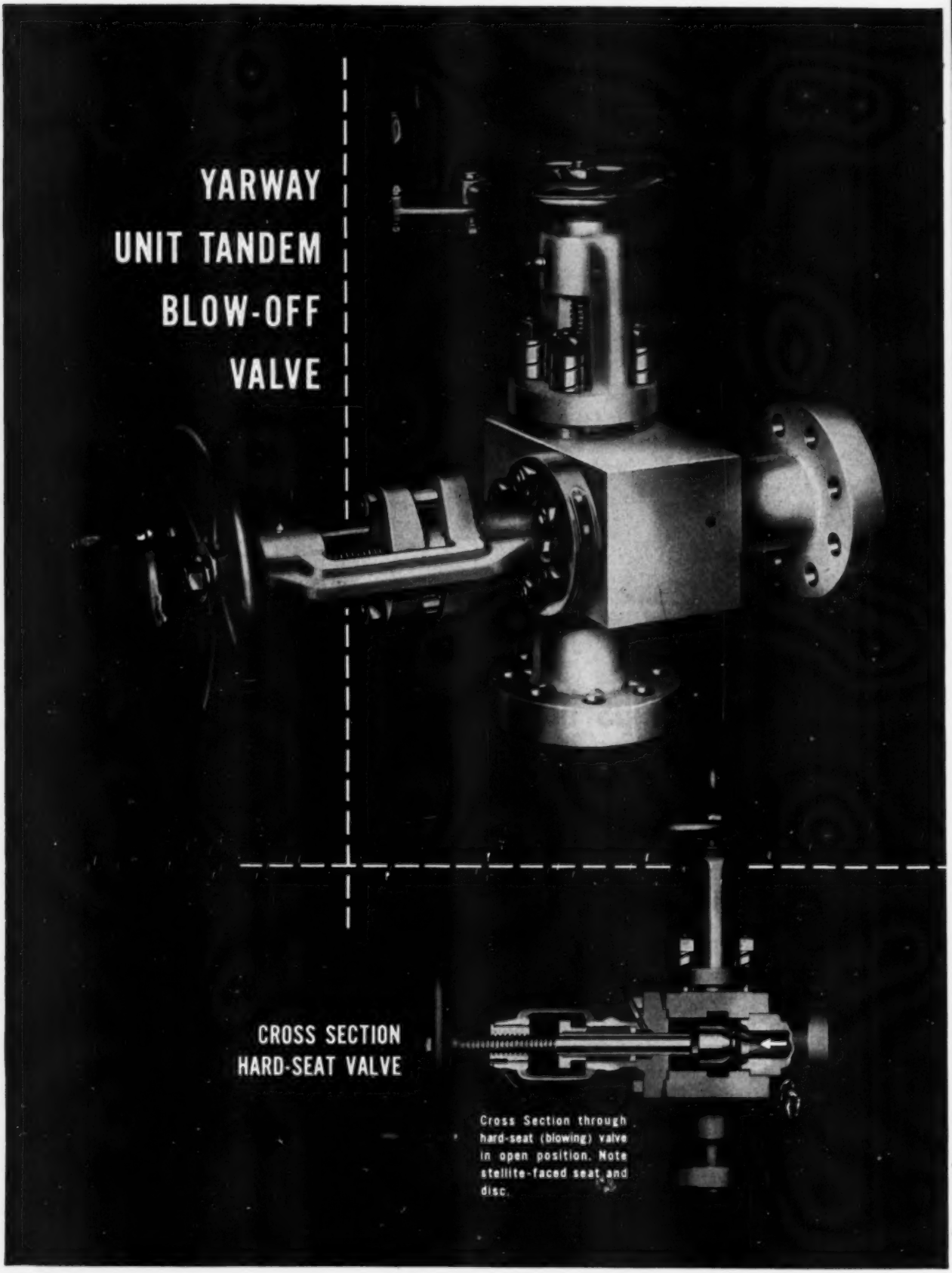


For Boiler Feed Service. Capacities to 3,000 GPM. Heads to 7,000 feet.

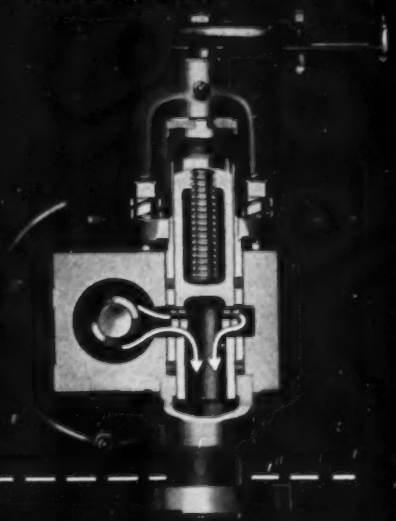
WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job


YARWAY
UNIT TANDEM
BLOW-OFF
VALVE
CROSS SECTION
HARD-SEAT VALVE
Cross Section through hard-seat (blowing) valve in open position. Note stellite-faced seat and disc.

CROSS SECTION
SEATLESS VALVE



Cross Section through seatless (sealing) valve in open position. (On pressures over 1500 psi two hard seat valves are recommended.)

RUGGEDNESS
...WHERE YOU NEED IT

A one-piece forged steel block serves as the common body for both valves in Yarway Unit Tandem Blow-Off Valves.

You get rugged strength where you need it... added protection for your high pressure boilers.

Whether in times of emergency, normal blowdown service, or acid washing, this high safety factor is a source of satisfaction to boiler plant operators.

Yarway Unit Tandems combine all advancements of modern metallurgy with experienced design and skilled workmanship. The result—DEPENDABLE PROTECTION.

POSITIVE ACTION
...WHEN YOU NEED IT

When putting high pressure boilers on the line, or in times of emergency, you need positive action at the blow-off valves.

With Yarways you have it.

Both the hard seat-seatless combinations and the hard seat-hard seat combinations provide positive opening and closing with drop-tight shut-off. Open yokes permit visual indication of the disc position in the hard seat valve and of the plunger in the seatless valve.

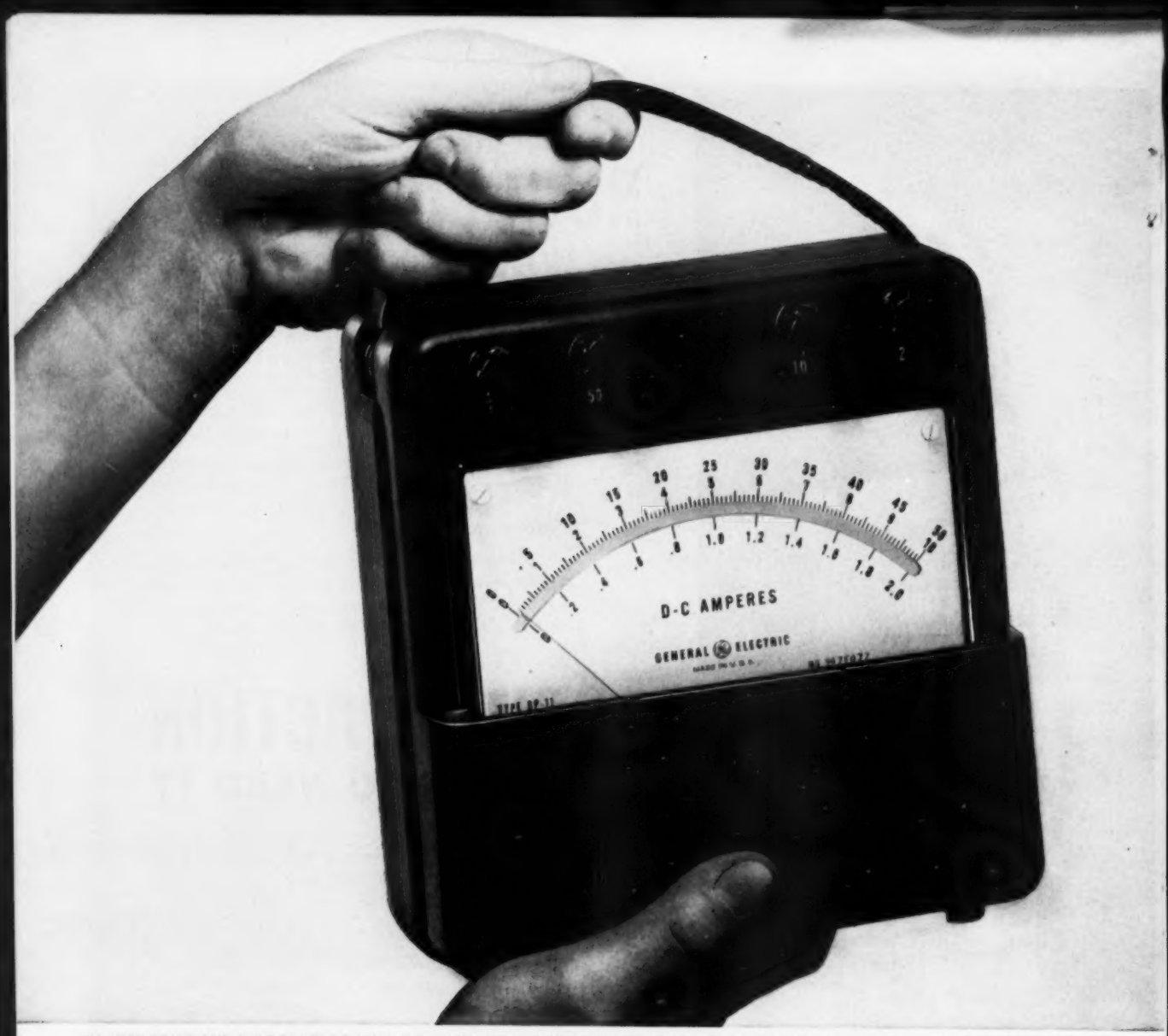
These are some of the reasons why *more than 4 out of every 5 high pressure plants in the United States are Yarway-equipped . . and* among boiler plants of all pressures, *more than 16,000 are Yarway-equipped.*

Write for your free copy of Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

blow-off valves



5½-INCH SCALE AND SHADOW PROOF DIAL GIVE THIS NEW D-C INSTRUMENT HIGH READABILITY—FOR FAST, CORRECT MAINTENANCE CHECKS

G.E. Announces New Portable Instrument

General Electric's new line of DP-11 portable indicating instruments has been designed with the practical measurement problems of the electrical maintenance man in mind. Readability, capacity to withstand rough treatment, and dependability—these working qualities are inherent in the product features described below.

Twin to the DP-11 line is the new DP-12 instrument group. The DP-12 offers a more refined instrument for applications where higher accuracy is desired—laboratory testing, and high-accuracy field work. In addition to this greater accuracy the DP-12 has all the improved features of the DP-11.

IMPROVED READABILITY

The dial of the DP-11 indicator is a long, readable 5½ inches. By making readings easier, this feature cuts down errors, speeds maintenance schedules.

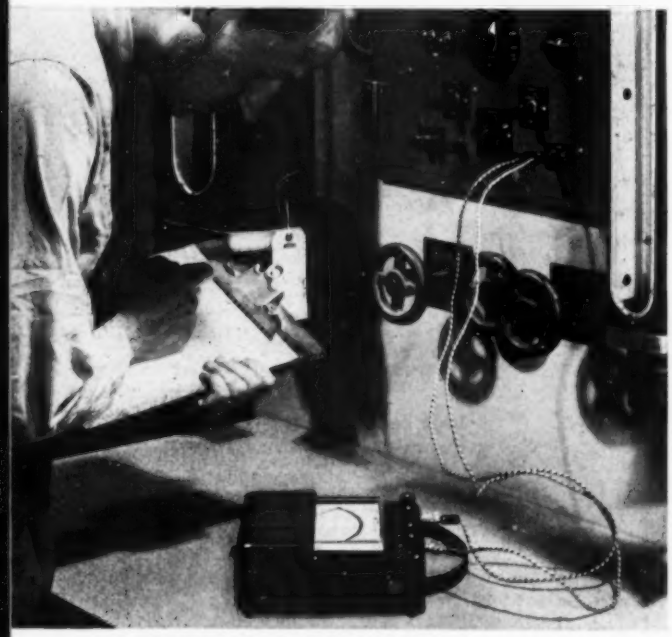
Readability is further increased by the molded plastic window, which permits flooding the entire scale with light from the front and three sides.

STURDY DESIGN

A thick Textolite* case enables the DP-11 instrument to stand up against the rough handling unavoidably given portable instruments. Also, shocks and jars are absorbed internally by spring-mounted jewel bearings.

CONCENTRIC MAGNET SYSTEM is shielded against stray magnetic fields with a soft-steel ring. Self shielding helps to assure uniformly accurate readings. System provides maximum magnetic efficiency.

PROTECTIVE EXTRA-THICK CASE is molded of durable Textolite* for greater resistance to breakage. Rounded corners also contribute to strengthening the case.



EASY-TO-READ DP-11 INSTRUMENT helps to speed checking of critical testing facilities required for producing jet aircraft mass flow-meters. Scale clarity reduces possibility of error.

HIGH-ACCURACY DP-12 PORTABLE INSTRUMENT (indicator at right) is used in conjunction with tachometer generator sets to calibrate rpm indicators for switchboards.

Featuring Improved Readability, Sturdiness

This all-round durable construction means the General Electric DP-11, -12 instruments will give you repeatedly good performance with a minimum of maintenance and out-time.

MANY TYPES AVAILABLE

Both the DP-11 and DP-12 portables are available in several ranges as ammeters, voltmeters, millivoltmeters, milliammeters, and microammeters. The DP-11 is accurate within ± ½ of 1% of full scale and the DP-12—within ± ¼ of 1% of full scale value.

MORE INFORMATION

For further details on how the DP-11, -12 instruments can help you to speedier, surer measurements, contact your G-E Apparatus Sales representative, or write for bulletin GEC-979 to Section 602-254, General Electric, Schenectady 5, New York.

*Reg. trademark of General Electric Company

GENERAL ELECTRIC

Little stories of big savings in LAGONDA tube cleaning

The case of the Experimenting Refinery

● One of the big eastern refineries, experienced in cleaning their tube stills mechanically, the Lagonda way, figured they'd try the same method on their power boilers to see how costs compared with the approved chemical method formerly used. They found out a lot. Cleaned all tubes inside and out in two large B.&W. boilers, and even with the labor costs of mechanical cleaning, they saved actually *more than two thirds* over chemical cleaning charges! Did it faster, too, which is certainly an item.

Just shows it doesn't pay to take some things for granted—and it does pay to try out Lagonda tube cleaning. Why not do it soon?

Y2-2

GET BULLETIN Y-29
with details on all types of cutter heads and motors for cleaning all tubes, small, large, curved, straight. On request.

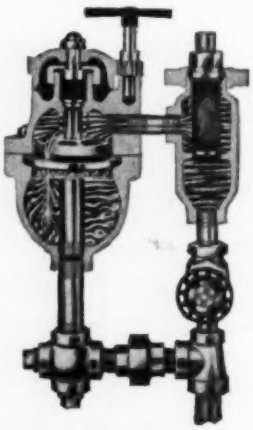
LAGONDA
...the oldest name in tube cleaning!

ELLIOTT COMPANY
LAGONDA DIVISION · SPRINGFIELD, OHIO
Plants at: Jeannette, Pa. • Ridgway, Pa. • Amperr, N. J. • Springfield, O. • Newark, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

new equipment

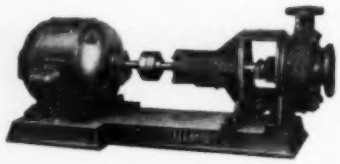
(Continued from page 16)

megohms, and about 50 ma at short circuit. A detector can be supplied for locating faults by the impulse method. Operation is discussed in a 12-page bulletin.



Unit reduces heat loss in boiler blow-off systems

H28 Accurate regulation of continuous boiler blow-off systems is said to be provided by an orifice meter developed by Madden Corp. The unit incorporates an orifice plate with 17 calibrated orifices. The desired size can be easily and quickly brought into the line of flow, thus making it possible to change or regulate flow according to requirements. Unnecessary waste of water and fuel is therefore said to be eliminated.



Centrifugal pumps available in larger capacities

H29 Capacities of end suction, centrifugal pumps manufactured by Warren Steam Pump Co., Inc., have been increased to 1000 gpm, with heads to 400 ft. Features of the units, designated as type DF, include double row thrust bearings, extra deep stuffing boxes, renewable case wearing rings, and a shaft sleeve with a rubber sealing ring. Units can be adapted to pumping such liquids as water, condensate, solvents, brines, caustics,

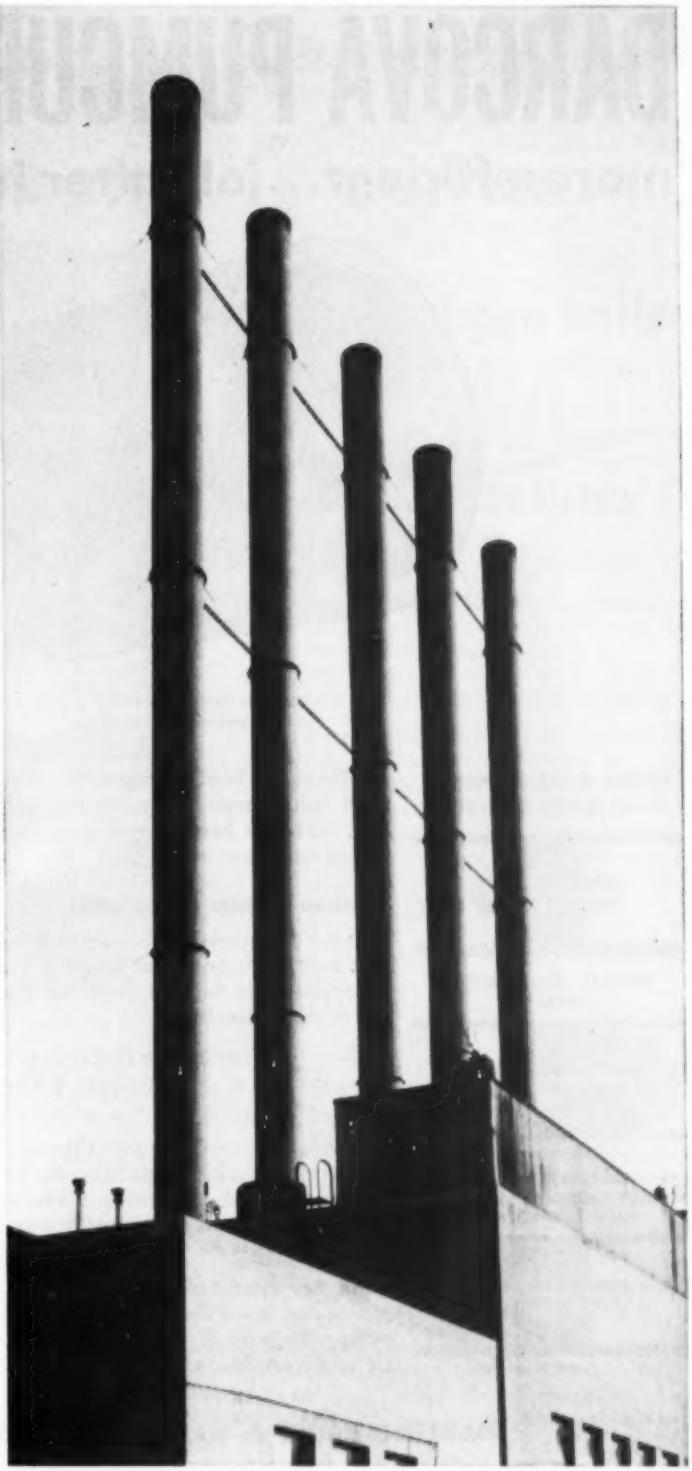
(Continued on page 24)

This Modern Chemical Producing Plant Used

BYERS WROUGHT IRON PLATES

TO KEEP THEIR STACK INVESTMENT FROM GOING

"UP IN SMOKE"



Because stack maintenance comes high, engineers of this modern chemical producing plant got "down to earth" facts before they selected material for the five new stacks at the Company's Chemical Plant, Louisville, Kentucky.

A thorough investigation of wrought iron's corrosion resistance, and past records of the material in stack service, indicated wrought iron plates as a solution to excessive maintenance and repair. The stack fabrication and erection job was turned over to W. E. Caldwell, Louisville. The stacks are 126 feet high and 54 inches in diameter.

With today's high maintenance costs, it's just plain good business to assure that every metal stack lasts as long as possible, with as little attention as possible. The importance of this move increases as stacks grow taller, for the higher the stack—the higher the cost of maintenance.

Byers Wrought Iron plate is a veteran in stack service. Engineering records provide convincing evidence of its superior durability. You can review some of these records, and see how wrought iron has helped others solve the problem of premature failure and maintenance by writing for a copy of our bulletin, WROUGHT IRON FOR FLUE GAS CONDUCTORS AND COAL HANDLING EQUIPMENT. It may help you . . . so write today.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

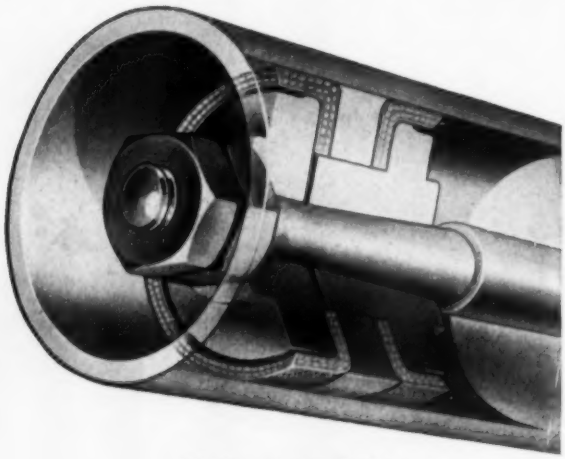
WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

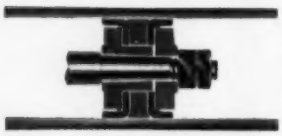
DARCOVA PUMCUPS

more efficient...job after job!

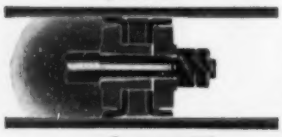


Phantom cutaway showing a typical Pumcup piston assembly.

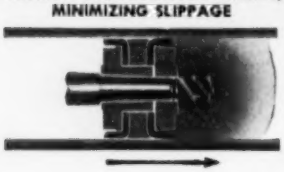
DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED



UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE



NO matter how tough your pumping problem Darcova Pumcups can help solve it . . . this has been proved in thousands of plants year after year.

Darcova Pumcup Advantages

1. Texture engineering that not only increases volumetric efficiency, but keeps it high with no appreciable fluid slippage for the entire life of the Pumcups.

2. Darcova Composition Pumcups give many times the life of other types of piston packing . . . *at least 3 to 1!*

3. Standard or special compositions are available for exceptional stability in handling almost *any* fluid . . . strong acids, alkalies, food products and even troublesome petroleum derivatives.

Send For Free Bulletin—Ask for Bulletin No. 4401 on Pumcups for reciprocating pumps; Bulletin No. 4502 on Pumcups for air and hydraulic mechanisms. Address . . .

DARLING VALVE & MANUFACTURING CO.

Williamsport 9, Pa.

DARCOVA® THE ORIGINAL COMPOSITION CUP

PUMCUPS

new equipment

(Continued from page 22)

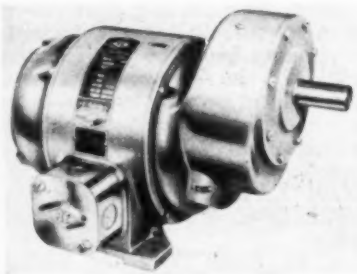
acids, organic liquids, hydrocarbons, gasoline, and oils. Construction is described in a 4-page folder.

Fitting is designed for plastic pipe

H30 Carlon Products Corp. has added a reducer insert tee fitting to its line of flexible plastic pipe fittings. The new tee, available in run sizes up to 2 in., provides a side outlet which is one standard pipe size smaller than the run. To provide a leak-proof joint, stainless steel clamps are used to draw the pipe down over serrations on the insert.

TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 99. Your requests will be handled promptly.



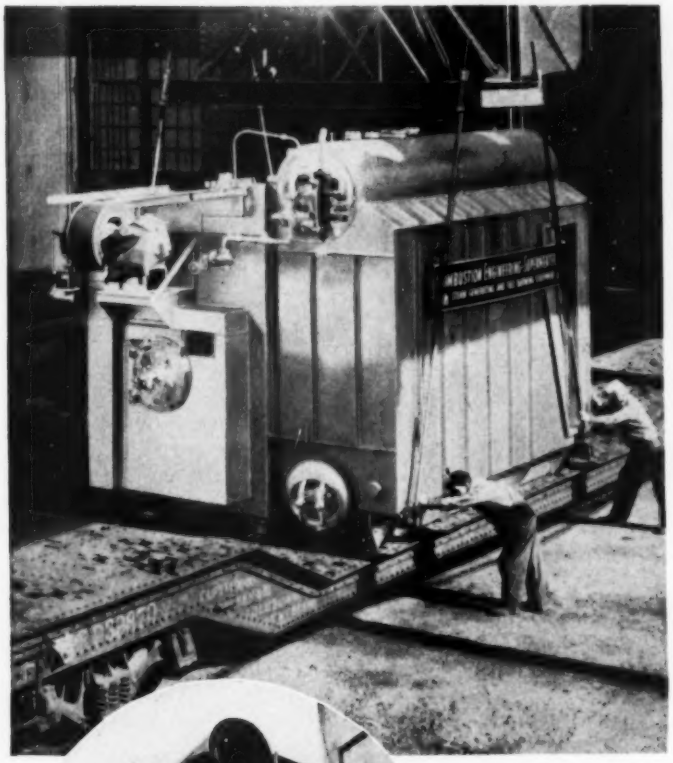
Speed reducer incorporates rotating endbell

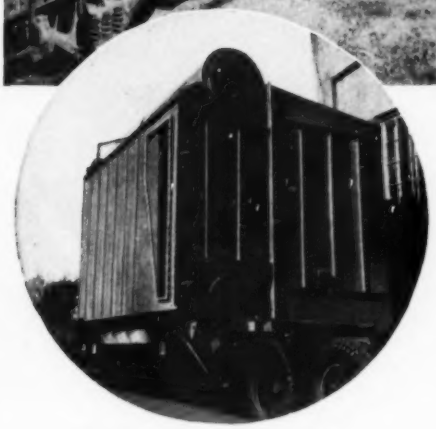
H31 Greater mounting and power-take-off versatility is provided by an offset-shaft speed reducer developed by Reuland Electric Co. By rotating the endbell, the unit's output shaft can be connected to the load either below, right, or left of the drive motor. Besides eliminating cost of fabricating mounting platforms, this feature assures true in-line hookups. Known as Motoreducer,

(Continued on page 30)

Don't settle for just A Package Boiler

INVESTIGATE THE VP BOILER





VP Boilers are available in capacities from 4,000 to 30,000 lb of steam per hr; pressures to 250 psi. Send for Bulletin VP-132.

...the Package Boiler with EXTRA features

If you're in the market for a Package Boiler, here's the problem you face. There are a number of water-tube package boilers being offered today. Most of them look pretty much alike. And, in some respects, they *are* alike.

But you're looking for the "best buy" in a package boiler. Therefore your interest lies in points of difference rather than points of similarity. The C-E Package Boiler, Type VP, offers all the better design features of its contemporaries *plus* the following extra features:

1. **Fully Water Cooled Furnace**—More cooling area per cubic foot of furnace volume than any other boiler of the VP's size and type. In all but the three smallest sizes, the VP Boiler has water-cooled walls on *all six sides* of the furnace—including the burner wall.

2. **Larger Lower Drum**—The 30-in. diameter lower drum permits a simple, symmetrical tube arrangement . . . provides easy access for washing down or inspection . . . its greater water storage capacity facilitates the handling of fluctuating loads.

3. **Centrifugal Fan**—This more efficient type of fan operates at lower speed than other types and is quiet in operation. In fact, its average noise level is less than half that of typical high-speed fans used on most package boilers.

4. **Simple Baffle Arrangement**—Minimum changes in direction of gas flow—no baffle at all in convection bank of larger VP Boilers. This means lower draft loss . . . simplified soot blowing . . . absence of dead pockets, thus, maximum heat pick-up. In the intermediate sizes, a water-cooled baffle assures minimum maintenance.

B-673A

COMBUSTION ENGINEERING, Inc.

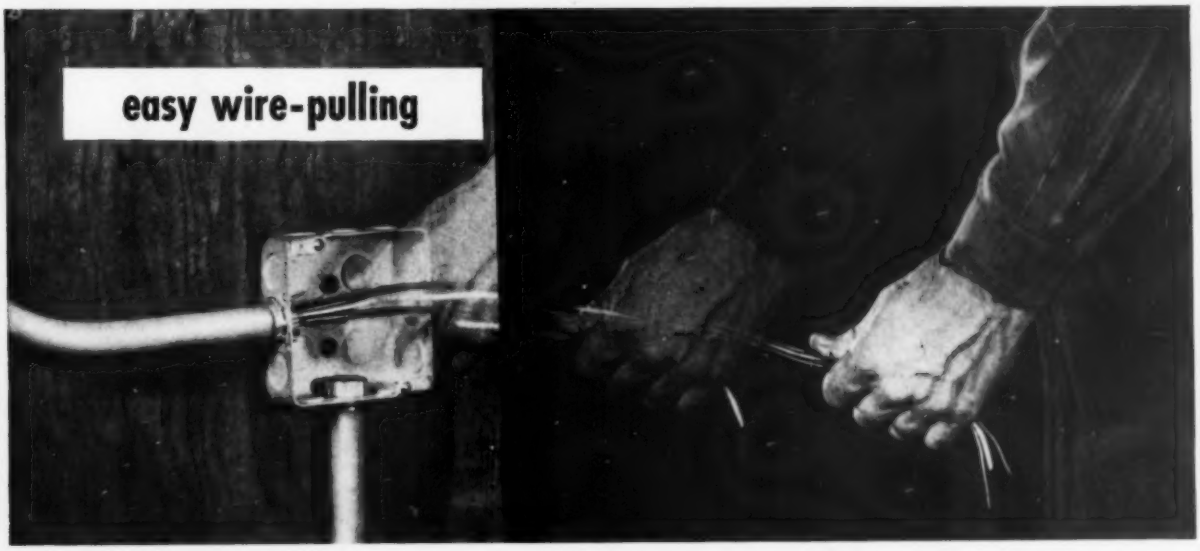
Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

G. E. announces

New G-E WHITE is easier to bend because the "metallizing" process eliminates the quenching and straightening that cause hardening.

new rigid conduit



Wire-pulling is easier because new G-E WHITE is lined with a new corrosion-resistant coating, containing an anti-friction agent. There is no roughness inside the conduit that might damage insulation.

A new G-E WHITE rigid steel conduit that has easy bending, easy wire-pulling, and improved corrosion-resistance characteristics has been introduced by General Electric's Construction Materials Division.

The result of an intensive research and development program, new G-E WHITE is now zinc-coated by means of a process called "metallizing." This process, while never before applied to rigid conduit, has been proved by more than 30 years of use on ships, pipelines, bridges, and trestles in damp and corrosive atmospheres.

In metallizing, pure zinc powder, reduced to a plastic state, is sprayed onto the conduit. This bonds a controlled, uniform coating of pure zinc to both pipe and threads to provide lasting protection against corrosion. Metallizing does not harden the conduit or form brittle zinc-iron alloy.

In addition to the metallizing process, a new anti-friction inside coating has been added to make wire-pulling easy . . . to provide permanent interior protection against corrosion.

The new G-E WHITE rigid conduit conforms with the American Standards Association specifications, is listed by Underwriters' Laboratories, Inc., and meets all U. S. Government specifications. Ask your distributor about the new G-E WHITE. Available in all size mixes. Section C24-844, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

Photograph courtesy of Metallizing Engineering Co., Inc.

Better Corrosion Protection — The corrosion resistance of metallizing has been proved by 30 years of service, and by exhaustive tests in G-E laboratories. The hull and superstructure of the ship above depend on metallizing for protection against salt spray. The new G-E WHITE conduit has the added protection of a coating of C-553 lacquer over the metallized zinc.

New G-E WHITE

You can put your confidence in—

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

CONDITION SLUDGE

...with Dearborn Formula 659

● Sludge—the ever-present thief of boiler efficiency—can be controlled with Dearborn's sludge-conditioning Formula 659.

IMPORTANT FUNCTIONS OF FORMULA 659

PREVENTS sludge from adhering to boiler surface.

PROVIDES colloidal action; prevents crystalline scale formation.

PRODUCES better quality steam by modifying bubble formation responsible for foaming conditions.

ELIMINATES corrosion in feed lines, heaters and internal boiler surfaces caused by dissolved oxygen.

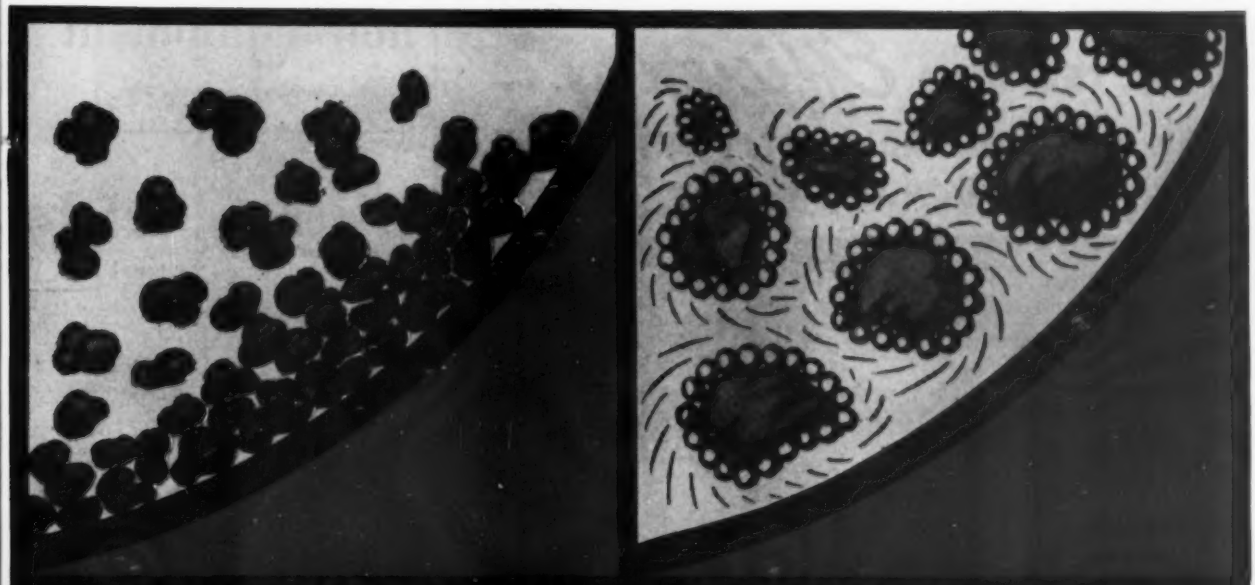
Compatible with other treatments, this Dearborn formula will greatly reduce maintenance and production costs.

Dearborn

TRADE MARK

COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois



THIS IS UNCONDITIONED SLUDGE

Untreated sludge particles settle into a compact mass, preventing water contact with metal surfaces and producing sludge-type scale.

THIS IS CONDITIONED SLUDGE

Treated sludge particles, surrounded by water molecules, produce fluid and non-adherent particles which prevent packing and attachment.

DEARBORN FORMULA 134 REMOVES SCALE

Many waters tend to form scale in pipes and cooling jackets, impairing valuable equipment, adding unnecessary labor and shutdown time. Formula 134, a concentrated solvent, removes scale in heat exchange units, boilers, pumps, feed lines, meters and condensers! Bulletin 5002 describes removal of scale with Dearborn Formula 134.

DEARBORN Filmeen Stops Return Line Corrosion

If corrosion makes frequent replacement of return lines, fittings and other equipment necessary, your plant engineer will want to know more about corrosion control with Dearborn Filmeen . . . Bulletin 5013 gives the complete story.

your Dearborn Engineer

will visit your plant, analyze the pertinent waters, make recommendations for the proper treatment and the equipment necessary to establish a simple control that eliminates unnecessary expense.

WRITE FOR THESE VALUABLE BULLETINS

Dearborn Chemical Company
Merchandise Mart Plaza
Chicago 54, Illinois

Dept. INP

Please send me

- ☐ Bulletin 5008-A—Dearborn Formula 659
- ☐ Bulletin 5000 —Dearborn Industrial Water Treatment and Engineering Service
- ☐ Bulletin 5013 —Dearborn Filmeen
- ☐ Bulletin 5002 —Dearborn Formula 134
- ☐ Have a Dearborn Engineer call

Name.....

Position.....

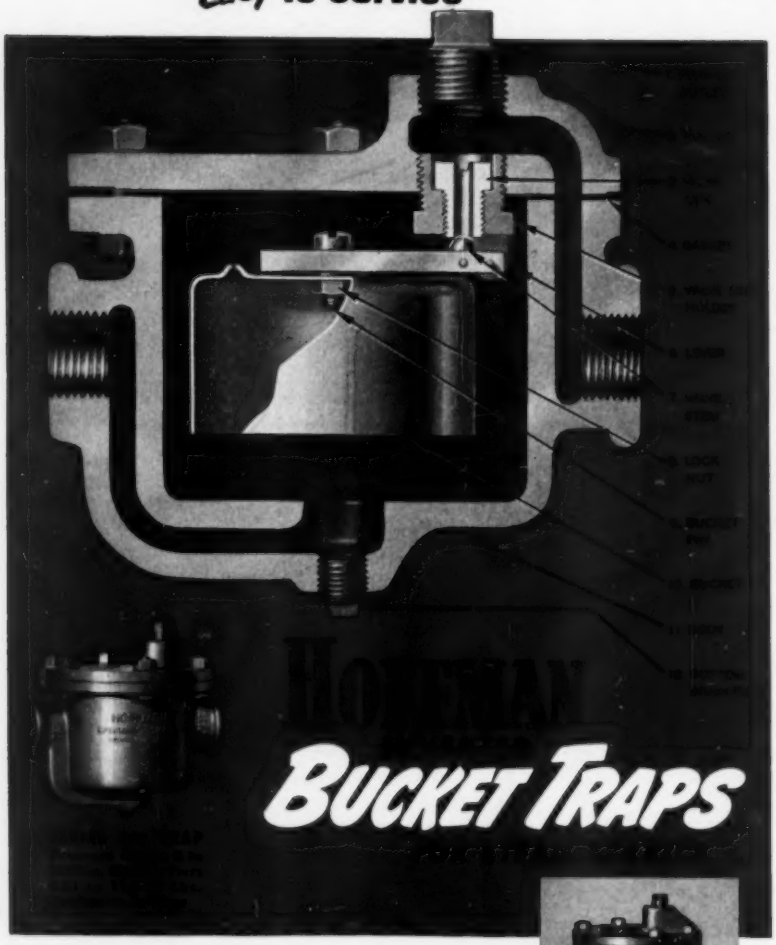
Company.....

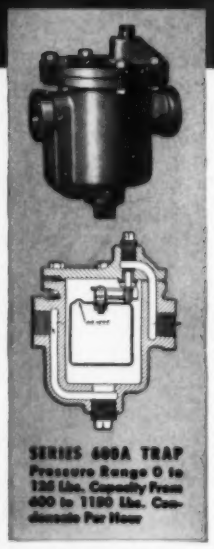
Address.....

City.....*State*.....

NOTED FOR *Efficiency...*

This simple mechanism is *Easy* to install... *Easy* to service





HOFFMAN Bucket Traps operate intermittently and are particularly applicable to draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. They are easily inspected, cleaned and serviced by merely removing the cover assembly.

Straight-through pipe connections permit close-to-floor installation.

All working parts are connected to the bonnet and are removable with it for service without breaking pipe connections.

These are features of design appreciated by the maintenance man in saving man-hours when manpower is costly and scarce.

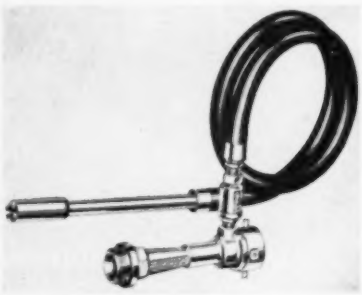
Hoffman Bucket Traps are adjustable to a wide choice of pressures, simply by changing valve seats. Send today for full information, no obligation.

HOFFMAN SPECIALTY MFG. CORP, Dept. I-P-8, 1001 York St., Indianapolis 7, Ind.
Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.
Sold by leading wholesalers of Heating and Plumbing Equipment.

new equipment

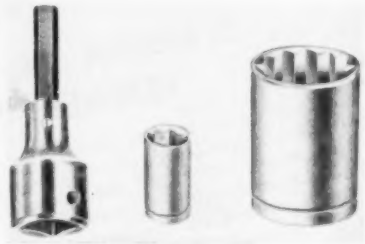
(Continued from page 24)

it is available in ratings of ½ to 5 hp, and in output speeds from 190 to 520 rpm. Additional versatility is gained by using fluid-shaft, slip ring, squirrel cage, or multi-speed motors. Magnetic brakes also are available.



Eductor introduces liquids into hose lines

H32 Rockwood Sprinkler Co. has developed a hose line eductor for proportioning of liquids into hose lines. The unit is designed particularly for wetting agents and for introducing Foam, the company's foam producing liquid, for use in extinguishing fires. Sizes are 1½ and 2½ in., with a female swivel coupling on the inlet side and a solid male connection on the discharge side. A 4-page folder suggests uses.

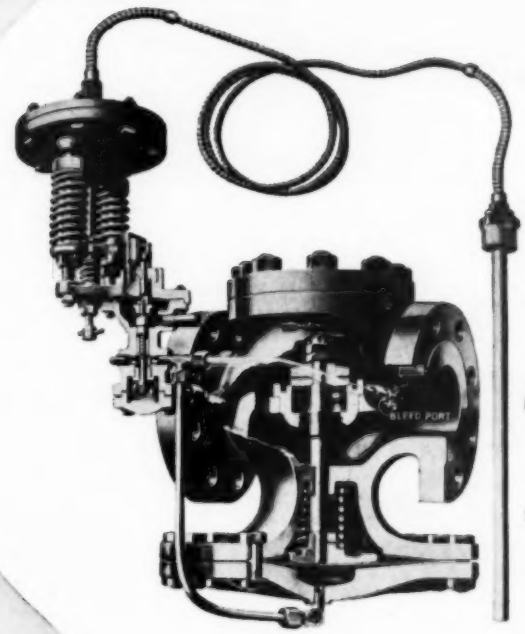


New wrenches extend manufacturer's tool line

H33 Hollow head screw and metric-size socket wrenches have been added to the Proto line manufactured by Plomb Tool Co. The sockets for hollow head, socket head, and Allen head screws are used extensively in many types of industries. Ten ⅜ in. drive sockets are available, ranging in hexagon bit size from ⅛ to ¾ in. and accommodating Allen-type screws from ¼ to ¾ in. The sockets with metric-size openings, needed for equipment manufactured in most European countries, include nine ¼ in. drive sockets with openings from 4 to 12 mm, and twenty ½ in. drive sockets with openings from 12 to 32 mm.

—End

3 Reasons for Accurate Regulation



PACKLESS CONSTRUCTION

LARGE BALANCED METAL DIAPHRAGM

SENSITIVE PILOT

Spence

Packless construction eliminates the need for closely fitted parts that may stick or bind due to dirt or uneven expansion of the parts.

In Spence Temperature Regulators, the Main Valve is actuated by a large balanced metal diaphragm which responds to the slightest changes in temperature.

Sensitive Pilots are designed to limit heater pressure to an adjustable maximum. As the temperature at the thermostat drops a few degrees there is a corresponding increase in steam pressure up to the limit for which the Pilot is set.

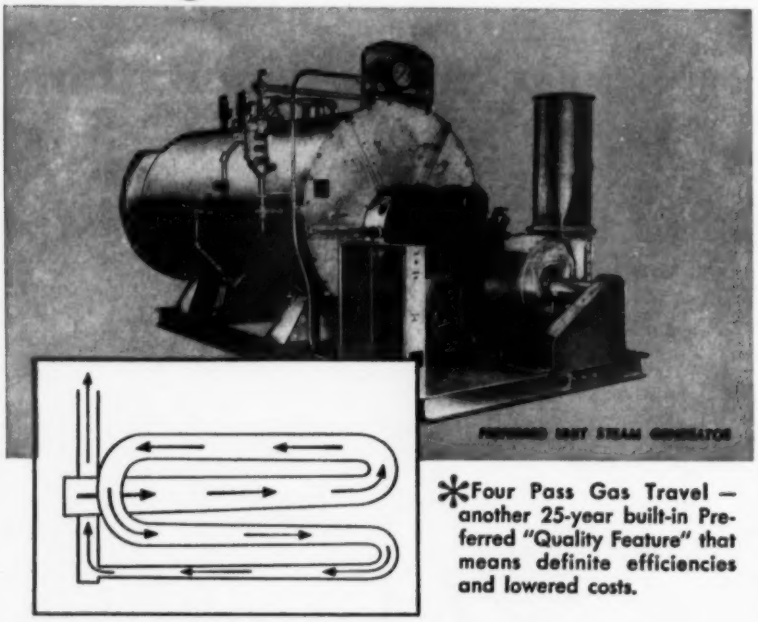
With regulators that respond only to temperature, an increase in load is accompanied by a momentary decrease in steam pressure caused by faster condensation in the heating element. There is a time lag until the thermostat senses the temperature drop and opens the valve wider. Spence Temperature Regulators act like pilot operated pressure regulators when this occurs. They respond instantly to maintain the steam pressure until the thermostat has a chance to further increase it as needed for the heavier load.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

SPENCE ENGINEERING COMPANY, INC., Walden, New York

there *IS* a difference*



*Four Pass Gas Travel — another 25-year built-in Preferred "Quality Feature" that means definite efficiencies and lowered costs.

in gas travel design that means MORE EFFICIENCY and CAPACITY with LESS MAINTENANCE!

Preferred's Unit Steam Generator, with FOUR-PASS GAS TRAVEL, insures a minimum of 80% efficiency and rated capacities that actually means — *MORE STEAM AT LESS COST.*

Everyone knows **heat absorption per square foot of heating surface increases as the velocity of the heated gases increases. To insure relatively constant high velocity throughout, Preferred *reduces gas passage area* to compensate for decreased gas volume. High gas velocity through the greater length results in high resistance to gas flow assuring even distribution of the gases, cleaner heat transfer surfaces with less tube cleaning, and lowered stack temperatures *year after year.***

Hundreds of plant engineers and consulting engineers readily admit that you can buy cheaper unit steam generators but the general consensus of opinion is—*you can't buy anything better than a Preferred!*

For all the facts, write today for your free copy of Bulletin 2000 . . . see for yourself just how Preferred is different and why it's a better buy.

PREFERRED UTILITIES MFG. CORP.

207 1860 BROADWAY · NEW YORK 23, N.Y.

letters

. . . from readers

Centrifugal Pumps

Gentlemen:

I have read the article "Centrifugal Pumps" in the June issue of INDUSTRY AND POWER with keen interest.

Is the seal illustrated in Fig. 4, page 95 available for installation in the field on user's pumps or is it a pump manufacturer's seal designed for use on his pumps only?

Harvey L. Gunn
Consulting Engineer
The Exchange Orange Prod. Co. (Sunkist)
Ontario, California

— The seal illustrated was designed by the Worthington Corporation for use on its pumps only; at present it is not available for use on other manufacturers' equipment. Negotiations are under way with an independent company to license them to manufacture this seal, making it more generally available.

English Interest

Dear Sirs:

I have read with great interest your survey "Adjustable Speed Drives and Electrical Controls."

Unfortunately the loan of this report through the usual library services is much too short a time for the close study the subject deserves, and I should, therefore greatly appreciate a copy of this report.

Thanking you in anticipation of any assistance you may be able to render.

R. Naisbitt
Prescot, Lancashire, England

Influencing Industry

Gentlemen:

I . . . decided to ask you for a copy of the following article from your May issue: "Accelerating Wound Rotor Motors."

A wonderful article, one that will influence the industry.

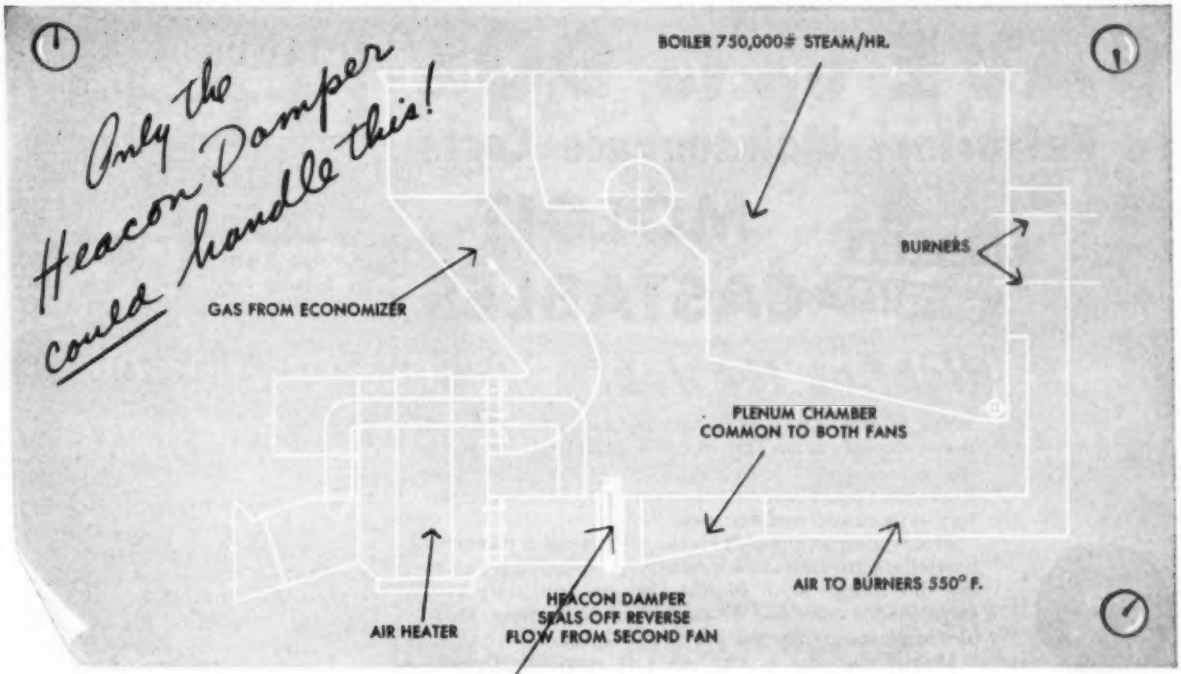
O. Meykar
Application Engineer
Westinghouse Electric Corp.
New York, New York

Supply Runs Out

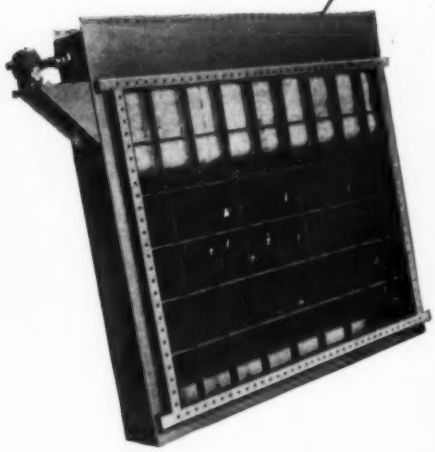
Gentlemen:

You recently sent us a quantity of reprints on unit substations, an

(Continued on page 34)


Only the Heacon Damper could handle this!
BOILER 750,000# STEAM/HR.
BURNERS
GAS FROM ECONOMIZER
PLENUM CHAMBER COMMON TO BOTH FANS
AIR TO BURNERS 550° F.
AIR HEATER
HEACON DAMPER SEALS OFF REVERSE FLOW FROM SECOND FAN

One of Two Air Pre-Heaters cleaned *while* Boiler operates at half load



THERMIX HEACON

There's a big difference in temperature between the inlet and outlet sides of this Heacon Damper installation when the damper is closed. There has to be because in this large western utility, air pre-heaters are cleaned while the boiler operates at half load!

This is made possible only because Heacon Dampers can effectively shut off high temperatures without leakage . . . can assure safety of personnel while boiler is in operation.

No other damper could assure the tight sealing so necessary in this installation. No other damper could provide these important benefits:

1. Quick return on investment through savings realized by operating steam generator at one-half load or better during cleaning operation.
2. Elimination of internal strains and possible damage during complete boiler shut-down.
3. Safety of personnel during cleaning operation.

Performance will prove to you as it has for others that Heacon Dampers are the most efficient dampers available anywhere. *Performance* in this installation resulted in 6 repeat orders for a total of 25 dampers!

Heacon Dampers are designed and constructed to meet practically any pressure or temperature specification. Our engineers will be glad to discuss your damper problems with you.

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

(OFFICES IN 38 PRINCIPAL CITIES)

Canadian Affiliates: T. C. Chown, Ltd. 1440 St. Catherine St. W., Montreal 25, Quebec. 983 Bay St., Toronto 5, Ontario, Canada

SAVE up to 90%
in Refractory Maintenance Costs

POUR
TROWEL
or GUN
MOLDIT CASTABLES

Right on the Job!

With Moldit Castable Refractory Cements, you can make special shapes and monolithic linings—or patch spalled or eroded linings quickly, at low labor cost. Plant after plant reports reduction up to 90% in refractory repairs and maintenance.

Moldit linings and precast shapes provide a powerful barrier against heat erosion, slagging or spalling. Patching old linings with Moldit Cement *drastically* cuts maintenance costs and down-time of equipment. Doubles and even triples the life of the lining.

Moldit cold-sets quickly to full strength. Doesn't shrink. Water won't harm it. There's a Moldit Refractory Castable for every application. Write for data on Moldit.

EASY TO MIX

AIR-SET FASTER

MORE RESISTANT TO SLAG

Gunniting a 5½" thickness of Moldit Chrome Refractory Cement on a boiler floor for resistance to molten slag.

MORE HEAT RESISTANT

Ash hopper of large public utility boiler lined with Moldit-D Refractory Cement.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

130 WALL STREET, NEW YORK 5, N. Y.

letters

(Continued from page 32)

article which appeared in INDUSTRY AND POWER.

In distributing these reports, we find that we do not have enough to go around and would appreciate your sending us another 150 copies.

R. J. Wanek
Federal Electric Prod. Co.
Newark, New Jersey

Timely Articles

Gentlemen:

Please forward to the attention of the writer two copies of the article "Late Trends In Polyphase Induction Motors." Thank you very much for these timely articles.

Freeman Felt
Rayonier, Inc.
Shelton, Washington

Unexpected Response

Gentlemen:

Thank you for the tear sheets of the article by (our) Mr. Dodge, which appeared in your May issue ("Measuring Boiler Tube Temperatures"). We have received requests for a substantial number of copies of this article. In fact, the response has been wholly unexpected. To satisfy this demand, we plan to reproduce the copy, and are hereby requesting your permission to do so.

Richard A. Terry
Engineering Publications Section
Minneapolis-Honeywell
Regulator Company
Brown Instruments Div.
Philadelphia, Penna.

—Approval to reproduce Mr. Dodge's article has been granted.

Republication Request

Gentlemen:

I am very much interested in two stories which appeared in the May issue of INDUSTRY AND POWER, namely "Accelerating Wound Rotor Motors" and "Adjustable Speed Fluid Drives." Could I have permission to reproduce both of these articles in a future issue of the *PTC Bulletin*.

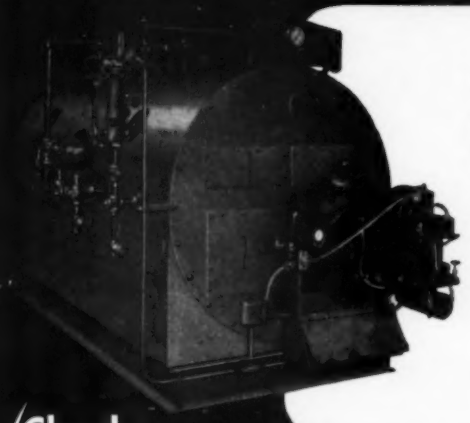
E. R. Rath
Executive Vice President
Power Transmission Council, Inc.
New York, New York

— Permission was granted.

SAVE FUEL-SAVE LABOR-

Choose Dutton!

TWO LINES TO SUIT YOUR NEEDS... BOTH FAMOUS FOR EFFICIENCY... LONG LIFE... LOW OPERATING COST



EconoTHERM...

the compact, automatic "packaged" boiler with exclusive Off-Center Firing

Compare it point-by-point — and you'll see *why* the EconoTHERM's advanced engineering *pays off* in fuel and labor saved! Off-Center Firing results in faster steaming and greater safety with guaranteed 80% efficiency. Completely automatic ... amazingly compact ... 5 or more square feet of heating surface per H.P. Gas or oil fired — to 250 H.P. Write for EconoTHERM Bulletin EC-52B.

Check First with Dutton

OTHER TYPES AND SIZES 5 H.P. AND UP

EconoMIST...

gives you 5-way firing convertibility... plus reliable H. R. T. design

Install it for gas, light oil, heavy oil, stoker, or hand firing — you can later convert the EconoMIST to *any* one of these firing methods. Highly adaptable, it's above all tremendously *dependable*. Of all "packaged" units, EconoMIST sets the standards for operating simplicity and low maintenance costs. Sizes from 15 to 105 H.P. Write for EconoMIST Bulletin EC-52B.

Handy Steam Cost Calculator mailed FREE on request... or ask your Dutton representative. (See Yellow Pages in Phone Book.)

Dutton BOILERS

DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO, MICHIGAN • BOILER BUILDERS SINCE 1880

OVER 500,000 GALLONS OF WATER are used every day in the Lakeland Company's tannery. This is the de-hairing area, where hides are being treated with a sulphite and lime solution.

THIS COMPACT WORTHINGTON TURBINE PUMP runs 24 hours a day, 7 days a week, assuring a constant, reliable water supply for the tannery.

Worthington vertical turbine pump cuts power costs at Florida tannery

Power costs at the Lakeland Tanning Company in Lakeland, Fla., decreased as soon as a Worthington vertical turbine pump was installed.

Previously, water was supplied by a pump handling 500 gallons per minute, and driven by a 50-hp motor. Every time the pump started up, every other electrical unit in the plant slowed down or dimmed. The smaller Worthington pump furnishes an adequate water supply and uses only a 15-hp motor.

Here's what H. C. Lutes, owner-president of Lakeland, writes about his Worthington:

> "We are well pleased with this pump. It has effected a considerable saving in electricity for us since its installation. No maintenance has been necessary, and this, of course, is a most important factor since our plant would be disabled in case of water failure. To any plant operator desiring trouble-free, dependable service, I would not hesitate to recommend the Worthington."

Reports like this are typical of those received from Worthington users everywhere. Find out how Worthington vertical turbine pumps can save *you* money. Get in touch with your nearest Worthington district office or write to Worthington Corporation, Vertical Turbine Pump Division, at Succasunna, New Jersey, or Denver, Colorado.

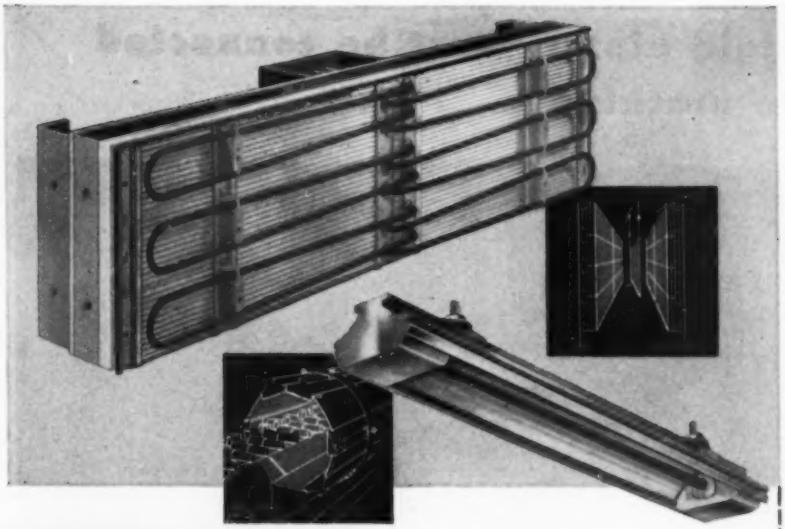
D.3.3

WORTHINGTON

Vertical Turbine Pumps

The World's Broadest Line Assures You The Right Pump For Every Job

CONSERVE GROUND WATER; IT IS A VALUABLE RESOURCE AND IS NOT UNLIMITED

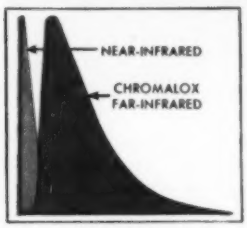


CHROMALOX *Far-infrared*

solves hundreds of heating problems

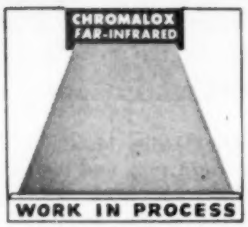
Here's your quick, economical and easy solution for curing, drying, degreasing, dehydrating, baking and other heating jobs. Pre-engineered Chromalox Units make oven building as simple as A-B-C, generate uniformly absorbed far-infrared heat for a multiplicity of processing needs. Temperatures up to 700° F. are easily selected, accurately maintained. Low initial cost, low write-off cost, low operating cost!

ONLY CHROMALOX GIVES YOU ALL THESE ADVANTAGES



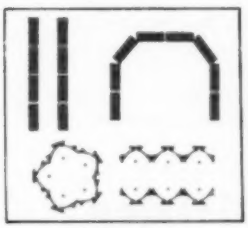
Color Blind Radiation

Longer far-infrared wave lengths are absorbed efficiently by all colors and textures.



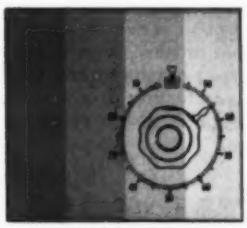
Heat Without Hot or Cold Spots

Chromalox radiant energy goes to work in a uniform pattern to span widest conveyor.



Low-Cost Oven Assembly

Pre-engineered Chromalox units require minimum expense to erect into complete ovens.



Infinitely Variable Heat Output

Heat from 0 to 100% of capacity to fit the exact temperature needs of the work.

plus

● **SHATTERPROOF CONSTRUCTION**—nothing to break or contaminate the work in process.

● **NON-DIMINISHING OUTPUT**—with all-metal Chromalox tubular far-infrared generators.

● **HIGH INTENSITY RADIATION**—with top BTUs per square foot.

● **QUICK HEAT-UP**—with energy transformed instantly into heat on the work.

● **ADDITIONALLY SAFE**-for any work involving volatiles.

● **MINIMUM MAINTENANCE**—Because of metal-sheathed, shock-resistant, long-lasting Chromalox tubular generators.

CHROMALOX *Electric Heat*
FOR MODERN INDUSTRY

DATA SHEETS

available to you on

APPLICATIONS OF CHROMALOX RADIANT HEAT

ABRASIVES
- ☐ R-111: Drying Silicon Carbide Discs
- ☐ R-122: Drying Abrasive Cloth

ASPHALT
- ☐ L-1055: Melting Korite Sealing Compound
- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries
- ☐ RP-203: Drying Asphalt Tile

AUTOMOTIVE
- ☐ R-126: Drying Tractor Parts
- ☐ R-118: Baking Synthetic Enamel on Gasoline Engines
  Also see, Paint Baking

BATTERY
- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries

BOTTLING (see Glass)

CERAMICS
- ☐ R-115: Drying a Water-Base Glaze on Ceramic Tile
- ☐ R-134: Preheating Dinnerware to Prevent Warping
- ☐ R-137: Drying Pottery

CHEMICALS (see Plastics)

COMFORT HEATING
- ☐ L-1077: Keep Men Warm, Keep Work on Schedule
- ☐ R-114: Comfort Heating for a Foundry Worker

DEGREASING
- ☐ R-116: Vaporizing Oil from Sheet Metal Parts
  Also see: Paint Baking

DRUGS (see Glass)

ELECTRONICS
- ☐ R-109: Drying Cement Base in Television Tubes

FINISHES (see Paint Baking, Degreasing)

FOUNDRY
- ☐ L-1060: Skin Drying of Molds
- ☐ L-1085: Core Drying
- ☐ L-1096: Shell Molding Goes Automatic
- ☐ R-113: Comfort Heating for The Foundry Worker
- ☐ R-130: Drying Precision Plaster Molds
- ☐ R-135: Shell Molding

GLASS
- ☐ C & R-2: Sterlizing & Preheating Bottles
- ☐ R-127: Heating Television Tubes to Bake Interior Graphite Coating

PAINT BAKING
- ☐ L-1064: Drying Lacquered Metal Parts
- ☐ L-1065: Improves Enamel Baking Five Ways
- ☐ L-1066: Bakes Big Parts or Small, Fast or Slow
- ☐ L-1080: Baking Paint on Radiators
- ☐ R-118: Baking Synthetic Enamel on Gasoline Engines
- ☐ R-119: Baking Paint on Metal Awnings
- ☐ R-131: Baking Paint on Meter Parts
- ☐ R-138: Drying Ink and Paint on Toothpaste Tubes

PAPER
- ☐ R-134: Drying Glued Paper Sheeting

PLASTICS
- ☐ L-1086: Drying Vinyl Coating on Imitation Leather
- ☐ L-1091: Post-Forming Formica
- ☐ R-101: Molding Kapok Center for Softballs
- ☐ R-102: Drying Plastic Powders
- ☐ R-104: Preheating Micarta Strips for Punching
- ☐ R-121: Dehydrating Vinyl Sheets
- ☐ R-123: Drying Plastic Laminates
- ☐ R-128: Curing Plastic Coating on Spring Clips
- ☐ R-129: Fusing Vinyl to Chip Board
- ☐ R-132: Embossing Vinyl
- ☐ RP-210: Heating Plexiglas for Vacuum Forming
- ☐ RP-202: Heating Thermoplastic for Vacuum Forming

PRINTING
- ☐ L-1090: Silk Screen Process Drying
- ☐ R-103: Static Removal
- ☐ R-107: Drying Ink on a Miehle Vertical Press
- ☐ R-108: Ink Drying on 8-Unit Web-Fed Offset Press
- ☐ R-110: Eliminating "Offset" on Duplicating Machines
- ☐ R-124: Drying Ink on a Goss Press
- ☐ R-136: Silk Screen Process Drying

REFRIGERATION
- ☐ L-1055: Dehydrating Refrigerator Coils

RESTAURANT
- ☐ Far-Infrared Food Warmer

RUBBER
- ☐ L-1056: Curing Latex Foam Sponge Rubber
- ☐ R-125: Cementing Crepe Rubber to Wooden Soles

TEXTILES
- ☐ L-1068: Fusing Vinyl to Cloth Work Gloves
- ☐ R-112: Dehydrating Braiding Material

EDWIN L. WIEGAND CO., Radiant Heating Div.
7520 Thomas Blvd., Pittsburgh 8, Pa.

☐ Send me application reports I have checked.
☐ Have a Chromalox Application Engineer get in touch with me.

Name_____

Company_____

Street_____

City_____ Zone____

State_____ IC-71

WHEREVER rigid piping must be connected to machinery

USE CMH FLEXIBLE METAL HOSE

YOUR GUIDE TO MOTION CONTROL

Catalog 130 gives specifications for all types of CMH hose. Write for a copy or see the Flexonics catalogs in Chemical Engineering Catalog and Sweets Plant Engineering File.

By using CMH Flexible Metal Hose as the connecting link between rigid pipe and machinery, you solve two otherwise serious problems—the elimination of damage to the piping because of vibration and the compensation for any misalignment that may exist. Properly installed, CMH Flexible Metal Hose will give long, dependable, trouble-free service without further attention.

Whatever your flexible connection problem, there is a CMH hose type to meet your needs. Corrugated and convoluted types are available in a wide variety of designs and in a complete range of sizes. CMH Flexible Metal Hose is offered in steel, bronze, stainless steel and other alloys to fill your requirements. Your Flexonics distributor will give you further data. Look for his name in your classified telephone directory or we will be pleased to send it to you.

CHICAGO METAL HOSE Division

Flexonics *Corporation* 1335 South Third Avenue, Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies CMH products that have served industry for over 50 years.

CMH

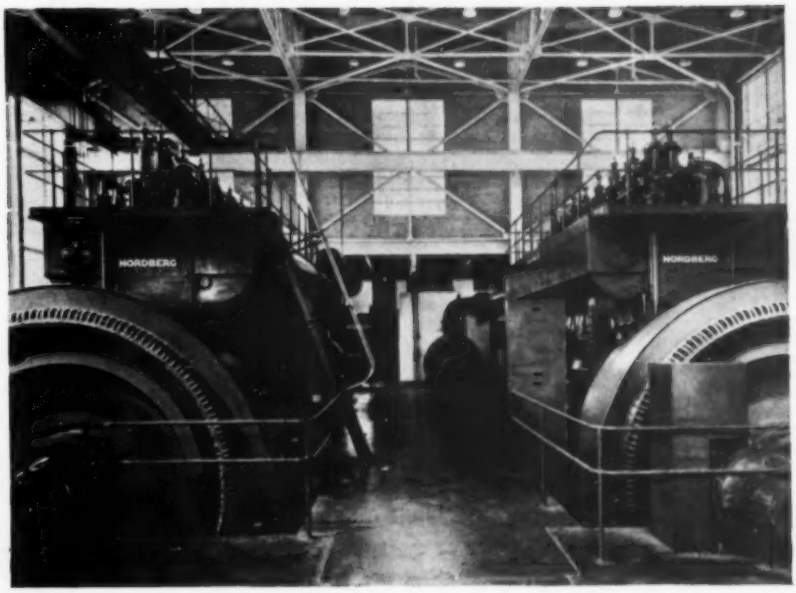
Flexible metal hose

Expansion joints.

Aircraft components

Metallic bellows

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines — makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

Why not let the facts prove to you, too, RUBILENE is a superior lubricating oil. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

Largest "S" Monel Pump Impeller ever cast at Inco's foundry. This 3,023-pound impeller is installed in an 84-inch Morris Vertical Axial Flo pump, at a generating plant of DOW CHEMICAL COMPANY, Velasco, Texas. The pump was built by the MORRIS MACHINE WORKS, Baldwinsville, N. Y., and is capable of handling 120,000 gpm at a total discharge head of 10.5 feet. It will operate in brackish water taken from the Gulf of Mexico. Because of Dow's experience with these corrosive conditions they selected "S" Monel for the impeller as a precaution against costly shut-downs. And for added protection, they also specified centrifugally cast pump sleeves of Monel.

"S" Monel...

an extra-hard casting alloy for parts subject to the severe conditions of power plant service

A time usually comes when you need a corrosion-resisting alloy of above-average strength and hardness.

Then it pays to remember "S"® Monel.

This member of the Monel family is one of the *strongest* and *hardest* of the non-ferrous alloys available in cast forms. Because of its hardness, of course, "S" Monel is highly resistant to abrasion and erosion. What's more, it combines the excellent corrosion-resistance of Monel with two particularly valuable features:

— extra hardness at high temperatures
— resistance to galling and seizing

Worth keeping in mind, too, is that "S" Monel maintains a hardness nearly as great as heat-treated steel. Temperatures as high as 1000°F. have but slight effect on its hardness.

And "S" Monel is machinable as cast. Where extensive machining operations are called for, the casting may be annealed. Age-hardening later will develop maximum hardness.

It is this combination of exceptional properties that makes "S" Monel so useful in valve discs and seats, wearing rings, bushings, sleeves, ejector nozzles, pump liners and impellers.

In your own plant, there are probably many places where Inco-Cast "S" Monel parts could contribute to the improved performance of parts subject to high stress, high temperature and severe friction under corrosive conditions. You can get complete information on "S" Monel — and assistance on actual problems, too — simply by writing to Inco's Technical Service Section.

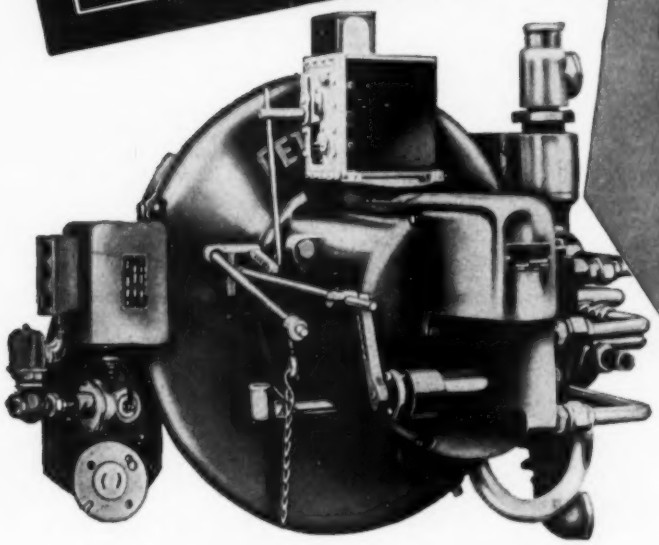
It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS
NICKEL • LOW CARBON NICKEL • DURANICKEL®

Are steam costs YOUR responsibility?



MODERNIZE WITH A **Petro** INDUSTRIAL OIL BURNER

and cut steam costs!

HERE'S WHAT PETRO WILL DO FOR YOU:

LOW FIRST COST

Petro industrial oil burners are designed and built to *modernize* the firing of your present boilers. This means that you save substantially on initial installation costs—yet enjoy the efficiency, the dependability, and the complete automatic operation that has been traditional with Petro burners for over 50 years.

LOWER FUEL COSTS

A Petro oil burner's economy is unchallenged. You save two ways. First, you save on fuel cost, because heavy oils cost less per gallon and have higher heat value. And second, a Petro burner is designed to burn these low-cost, heat-rich heavy oils with complete dependability. Whether the oil is thick or thin a Petro feeds it steadily under precise automatic control. You get more efficient firing.

UNUSUAL FLEXIBILITY

Here is another Petro value. Under automatic modulating flame control it is extremely flexible in following fluctuating steam demands. If yours is a problem of "high and low" steam requirements—than a Petro burner is your answer. It follows the load without hesitation, and throttles down to a steady low burning rate if desired.

LOWER OPERATING COSTS

Petro Industrial Oil Burners are completely automatic. They require a minimum of supervision. Boiler rooms stay clean. The simple, sturdy design of the Petro burner and its easy accessibility reduce upkeep to a minimum—save you money year after year.

Leading heating contractors everywhere recommend and install Petro oil burners. See your contractor, or mail coupon below.

INDUSTRIAL, COMMERCIAL, RESIDENTIAL—An oil burner for every firing need

PETRO

T. M. Reg. U. S. Pat. Off.

50 Years of Leadership in Automatic Heating and Power Equipment

PETRO, 3213 W. 106th St., Cleveland, Ohio
In Canada: 2231 Bloor St., West, Toronto, Ontario
Please send me the Petro catalog of commercial-industrial oil and gas-oil firing equipment.

Name _____

Address _____

City _____ State _____

LEFFEL *sells satisfaction...*

THE BROWN-BRIDGE
TROY, OHIO

OFFICE OF
JOHN A. SHARTLE

Mr. C. W. Schmidt
James Leffel & Co.
Springfield, Ohio

Dear Mr. Schmidt:

Many years ago, it became necessary for us to make a change in our steam equipment and we bought one of your Scotch Type Oil Fired Boilers. This boiler was so satisfactory that when we expanded our plant some time back we purchased another exactly like it and now they stand side-by-side doing a marvelous job to our satisfaction.

We feel that by the savings we have made we have paid for these two boilers many times over.

Very truly yours,

THE BROWN-BRIDGE MILLS, INC.

John A. Shartle, President

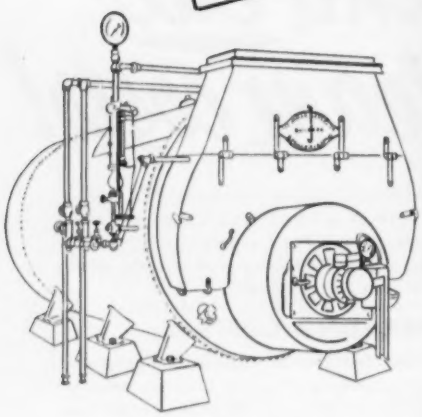
as well as
SCOTCH BOILERS

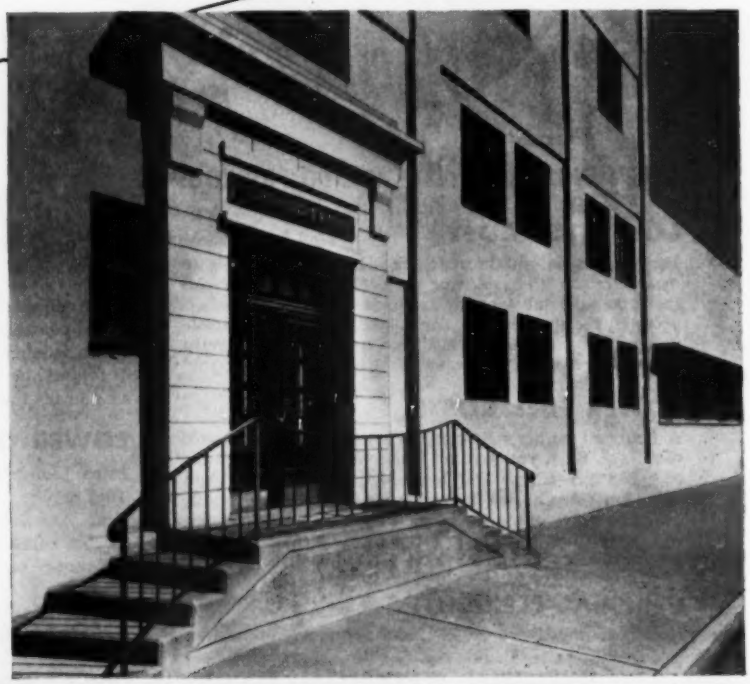
The trend to Leffel Scotch Boilers is greatest among those who have had previous boiler experience. Brown-Bridge Mills, Inc., Troy, Ohio, one of the country's leading manufacturers of gummed papers and gummed tapes, purchased a Leffel boiler years ago. It has served them ever since.

A recent plant expansion necessitated a second boiler. They specified an identical unit. Experience . . . ***experience with Leffel*** . . . pointed the way to year-after-year dependability and economy in steam.

Leffel Scotch Boilers are used in hundreds of industries where highest quality process steam is required. That is why Leffel boilers are frequently chosen when ***additional*** steam is needed.

Rugged, dependable, they come in a wide range of sizes; they burn ***gas, oil or coal;*** they convert easily from one fuel to another. Conservative ratings allow up to 100% overloads. Tell us your steam problem; we'll help you solve it.





Leffel is proud to have contributed to the progress of Brown-Bridge Mills, Inc., an industrial leader, whose plant entrance is shown here.

Sheet 8-30-52

FOUNDED IN 1867

THE JAMES LEFFEL & CO.

DEPT. C, SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT STEAM GENERATION FOR 91 YEARS

a new miniature indicator!

MEASURED VARIABLE — AIR-PILOT — COPPER TUBING

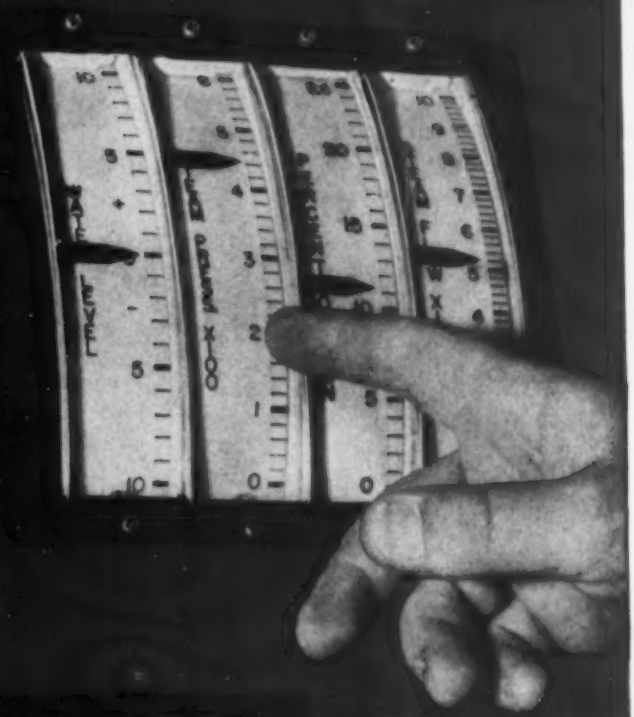
PNEUMATIC TRANSMISSION

MEASURED VARIABLE — DIFF. TRANSF. — AMPLI-FIER

ELECTRICAL TRANSMISSION

removable units—
interior illumination

easy to read—5 inch
scale, no parallax



easy correlation of
related functions

easy zero check
from the front

HAYS Miniscale Gages

This miniature instrument is especially suited for remote indication of such variables as pressure, draft, flow or level.

The scale is only 5 inches long — easy to read — internally illuminated. Choice of pneumatic or electric transmission.

Also available is the Hays direct reading miniscale gage for indicating *pressures* of fluids (steam, water, gas, oil, etc.) directly.

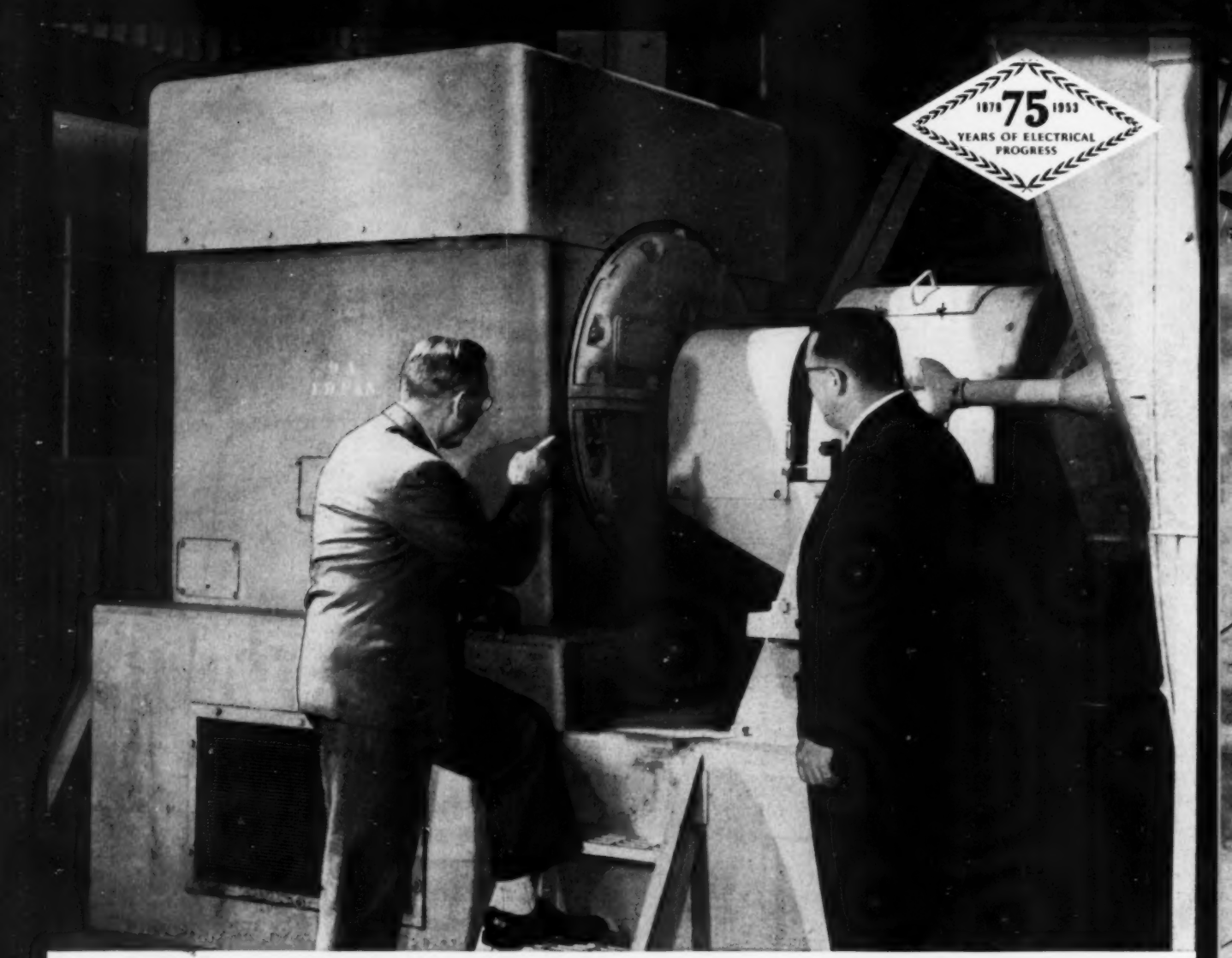
Gages are arranged for flush or semi-flush mounting. Either a yoke mounting, for as many as 12 units, or a keyhole clamp mounting for individual units can be provided.

Write today for full information on the Hays Miniscale Gages Bulletin 52-1075-223.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 2, INDIANA



DALLAS POWER & LIGHT SAYS:

"G-E Weather-Protected Motors Give Us Dependable Service."

The Dallas Power & Light Company reports complete satisfaction with G.E.'s Weather-Protected Motors, used to drive induced draft fans. Developed by General Electric in 1949, they are the first successful outdoor ambient breathing motors—give outdoor protection at lowest possible cost.

General Electric's Weather-Protected Motors are available as Base Ventilated for high shaft applications and as Grade Mounted for low shaft applications. They have an effective low air velocity, air reversal system which practically eliminates moisture, dust, and other foreign materials from the cooling air.

For full data, contact your G-E Apparatus Sales Office or write for Bulletin 5810 to General Electric Co., Section 753-4, Schenectady 5, New York.

GRADE MOUNTED Weather-Protected Motors are designed so that driven rain, etc. blows *through* the air inlets—not into motor.

GENERAL ELECTRIC

For power from steam DEALKALIZE WITH

AMBERLITE IRA-410

Without Acids or Degasifiers

Here are the facts about dealkalization with AMBERLITE IRA-410:

1. Alkalinity of water supplies for boiler feed and evaporator coolers may be conveniently controlled at low cost.
2. No acid-resistant or degasification equipment is necessary.
3. Because line pressure is not broken, pumping costs are eliminated.
4. Only low cost salt is required for regeneration—3 to 4 lb. per cubic foot of resin.
5. Combinations of the anion exchanger, AMBERLITE IRA-410, and the cation exchanger, AMBERLITE IR-120, permit simultaneous softening and dealkalization in a single column.

AMBERLITE is a trademark, Reg. U. S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

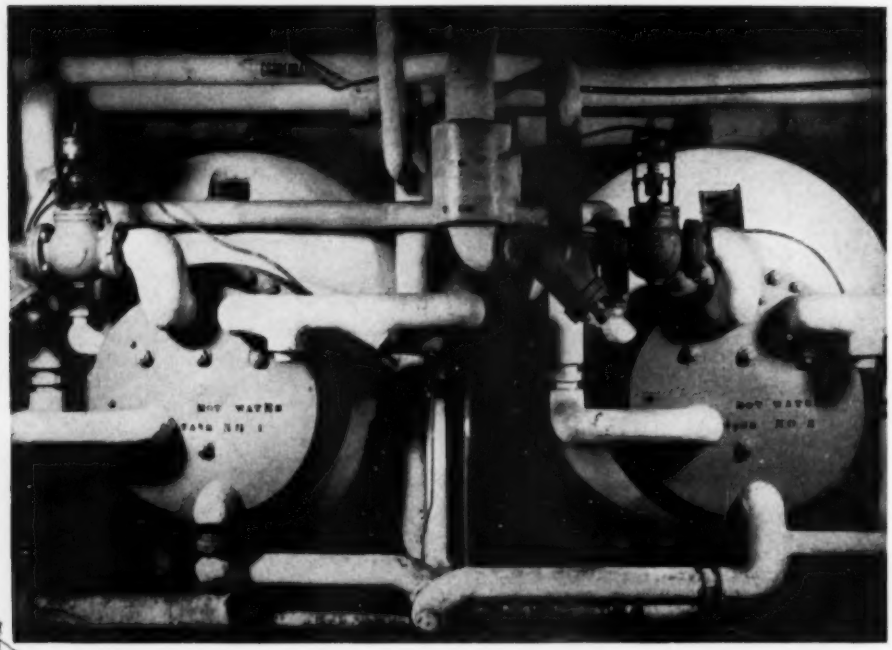
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

For more information about dealkalization with AMBERLITE IRA-410, write Dept. P-1 for complete literature. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-HI-LITES.



performing the same operation for 22 years to save hospital costs

At the Pratt Diagnostic department of the New England Medical Center Hospital in Boston, **p-k** hot water heaters have been performing their work successfully for 22 years and amputating part of hot water cost without anesthesia.

So satisfactory has the original **p-k** installation performed that recent additional equipment was specified **p-k**. The two new heaters are copper lined to insure clean, rust free hot water as required. Each unit heats 1100 gph from 40°F to 180°F. Each has an oversize condensate coil — 650 sq. ft. — which is cooling the heating system condensate from over 212°F to less than 130°F.

No matter what your heat exchange needs — heating or cooling — it will pay you to ask **p-k** for information now. Engineering guidance is available on call. Write now for Catalog No. 5.

the Patterson-Kelley Co., inc.

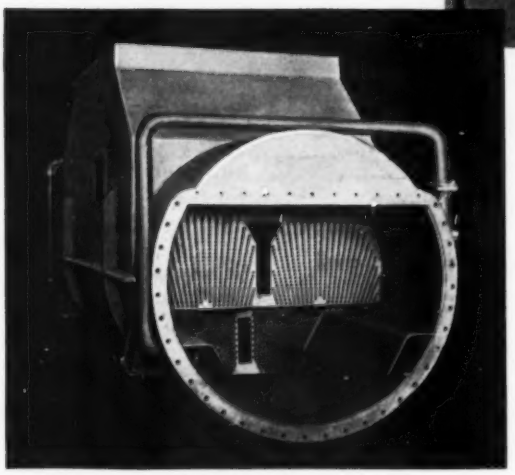
1180 Burson Street, East Stroudsburg, Penn.

1953

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

Elliott careful engineering builds better condensers

An Elliott 5000-sq. ft. divided water-box condenser installation. Condenser is equipped with Elliott twin two-stage air ejector. Elliott Crocker-Wheeler motors drive circulating water and condensate pumps.



This view of a 10,000-sq. ft. condenser with tube plate removed shows the fan type tube layout, partial tube supports, and air intake baffles.

THIRTY-FOUR YEARS of step-by-step development are back of the Elliott Type F Surface Condenser, and have resulted in a number of advances providing for better, more efficient operation. The most important of these results are:

1. *Maximum penetration of steam, with minimum pressure drop, due to improved tube layout.*
2. *Condensate temperature equal to steam temperature.*
3. *Minimum oxygen content of condensate.*
4. *Minimum terminal difference – the temperature difference between steam in the top of the condenser, and the discharge water.*

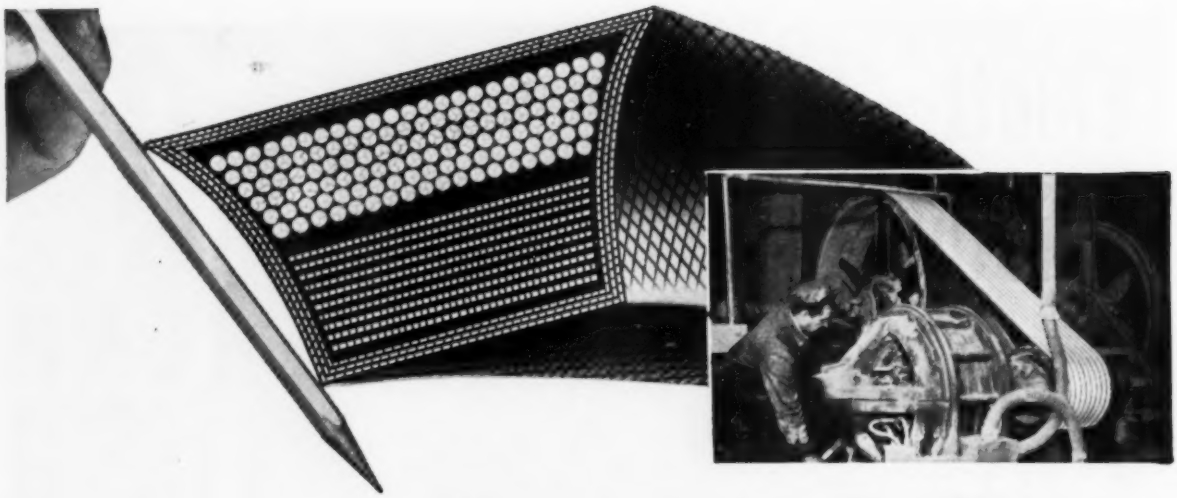
A further advantage in Elliott Type F condensers is the partial tube support design, in which support plates for the upper and lower tube banks are staggered rather than continuous, and thus do not divide the condenser chamber into cells, causing excessive pressure drop or dead spaces.

Type F condensers are built in sizes from 500 to 15,000 sq. ft., in both divided and undivided water-box type. They can be designed to meet specific space conditions. For details, contact your local Elliott engineer, or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

CONDENSER DEPARTMENT

C3-1



Gates V-Belts are built with CONCAVE SIDES

(U.S. PATENT NO. 1813698)

...that's why they last longer!

If you want lower V-Belt costs, just make this simple test...pick up *any* V-Belt and bend it as if it were going around a pulley.

As the belt bends, grip its sides between your fingers and thumb.

If the belt has *straight sides* you feel the sides bulge out. This forces the sides of the belt to press *unevenly* against the V-pulley . . . and you get concentrated wear at the points shown by the arrows.

Now, try this same test with the V-belt that is built with CONCAVE SIDES —the Gates Vulco Rope.

As this belt bends, you can feel the CONCAVE SIDES *fill out* and become perfectly straight.

These sides press *evenly* against the V-pulley. All wear is distributed *uniformly* across the full width of the Gates Vulco Rope and the CONCAVE SIDES therefore mean longer belt life and lower V-Belt costs for you.

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES—the Gates Vulco Rope!

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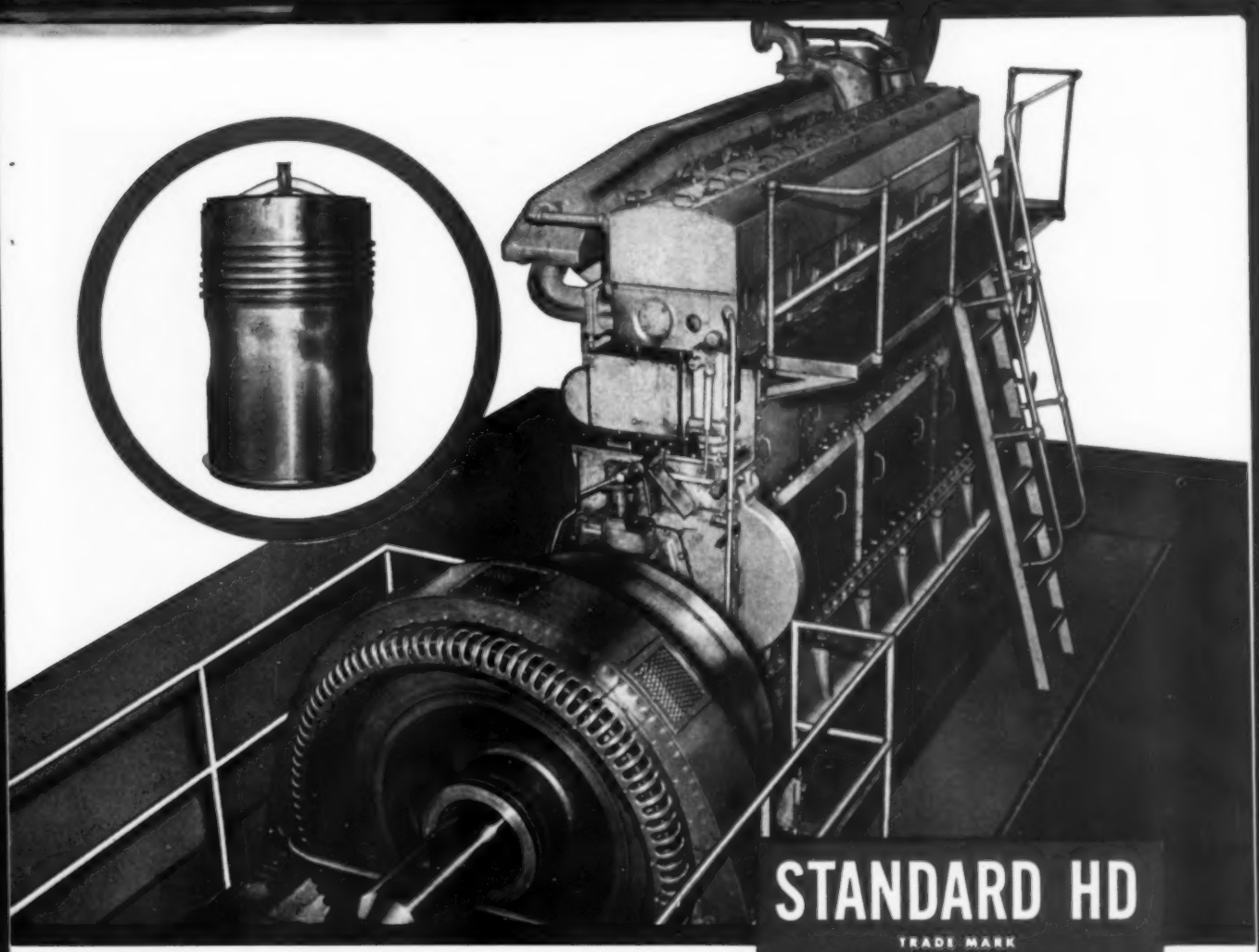

21,000 hours young!

● This 1320-hp diesel engine has provided many hours of economical service for the City of Benson, Minnesota, Water and Light Department since it was installed in October, 1948. It has been operated on an average of 20 hours each day and has generated over 13 million KW at an average load factor of 75%.

In this hard-working diesel, the lubricating performance of STANDARD HD Oil has been outstanding, particularly in view of the fact that crude oil has been used as fuel. Visual evidence of the clean, protective lubrication provided by STANDARD HD is presented in the above unretouched photograph of a piston removed from the diesel after 21,000 hours' operation. Deposits are at a minimum; rings are free. The original fill of STANDARD HD has not been changed, yet a recent examination and analysis of the oil showed it to be in excellent condition.

Diesel operators throughout the Midwest are receiving service like this from STANDARD HD Oil. The Standard Oil lubrication specialist serving in your section of the Midwest will be glad to give you information about the use of STANDARD HD in plants near your own. Just phone your local Standard Oil office. Or, write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*

IT FLOATS ON THE LOAD!*

You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

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*. . . resulting in fast heat-up of equipment, more production per day.

YARWAY | ***impulse steam trap***

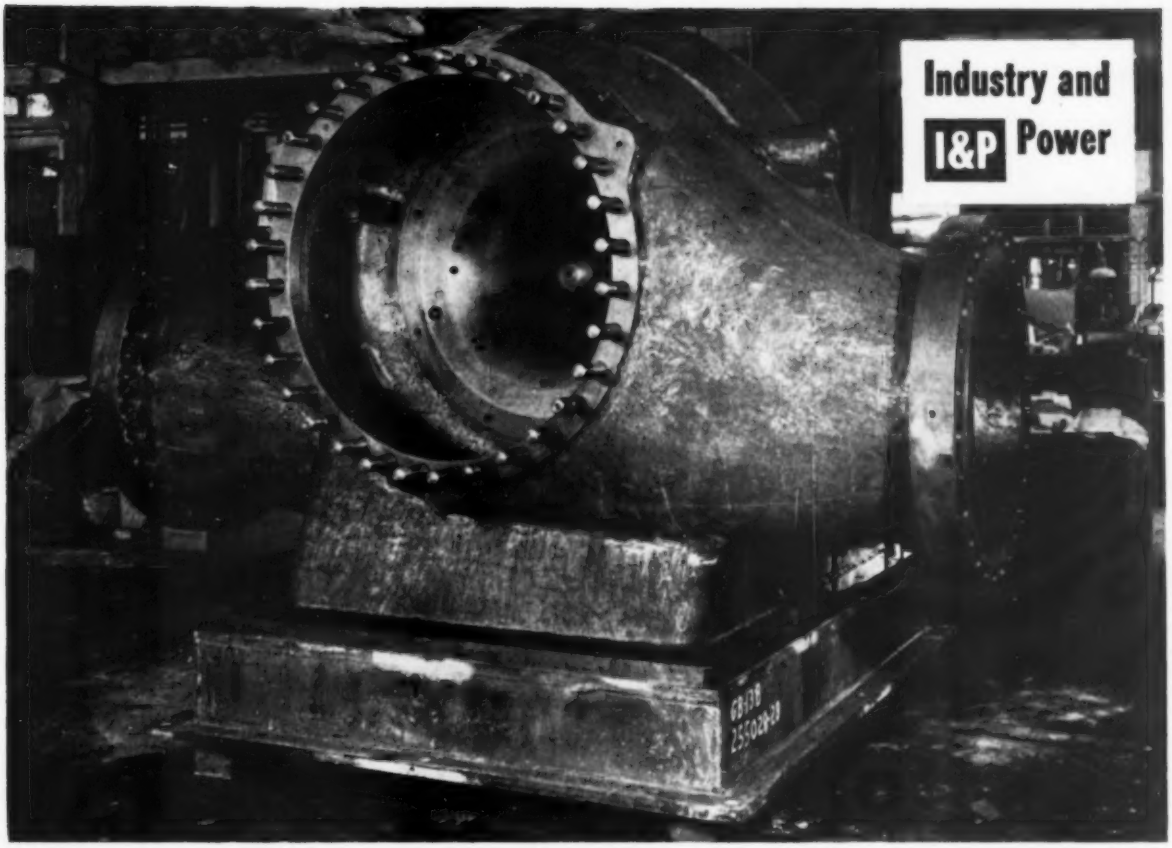


Fig. 1—This centrifugal compressor is designed for 1000 psig pressure. Suction is at right and discharge is at left.

Centrifugal Pipeline Compressors

. . . a new tool for a growing industry

C. F. KOENIG
Assistant Chief Engineer
Compressor Department
De Laval Steam Turbine Co.

THE CENTRIFUGAL pipeline compressor is proving to be an excitingly new and valuable machine for pumping large quantities of gas through this nation's expanding pipeline systems. Operators of new centrifugal booster stations encounter a machine with different appearance, design characteristics, and operating methods from the piston compressors previously used for this service. Questions frequently asked are: What are the important design and construction features of the machine? What accessories does it require? What are its operating characteristics? What causes surging, and how is it controlled?

Design Features

Centrifugal compressors are rugged, heavy duty machines designed to operate for long periods with a minimum of attention. The rotating parts are manufactured with great precision and are balanced carefully to insure almost entirely vibration-free operation at speeds up to 6000 rpm or higher. Large amounts of power are absorbed in relatively small packages, as illustrated by the compressor shown in Fig. 1. This unit would fit into a space 10 ft x 8 ft x 7 ft, but will pass over one-trillion standard cubic feet per day and absorb 7500 horsepower. The machine weighs over 22 tons, most of which is accounted for by the heavy cast steel case designed to withstand gas pressures up to 1000 psig and to resist bending and twisting moments which may be transmitted to it from the attached gas pipes.

In common with fans, propellers, centrifugal pumps, and jet engines, a centrifugal compressor does its work by "pushing" the gas it compresses rather than by "squeezing" it. The working element of the machine consists of one or more impellers mounted on a shaft which is spun at high speed by an electric motor, a steam or gas turbine, or a gas engine whose output shaft speed is multiplied by gears. Each impeller has a series of shaped blades which "scoop up" the gas at a point near the shaft axis and discharge it at a larger diameter and at a high velocity. This high velocity stream is decelerated in carefully contoured stationary passages so that its velocity

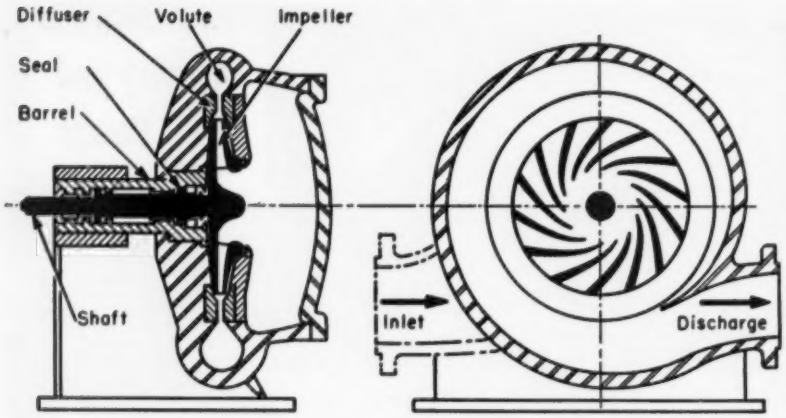


Fig. 2—Essential elements of a single stage (one impeller) centrifugal compressor.

These units serve a 30 in. pipeline.

head is converted efficiently to pressure.

Fig. 2 shows schematically the essential elements of a single stage (one impeller) centrifugal pipeline compressor. Gas enters the compressor through a large, flanged opening on one side of the case and is channeled to the impeller inlet. Deceleration is accomplished in the diffuser and volute. The gas leaves the compressor through another flanged opening on the opposite side of the case. Gas velocities at the compressor flanges are normally from 50 to 80 fps and are kept as low as practicable to avoid pressure losses.

Within the compressor the dynamics of compression call for much higher velocities, and the gas stream leaving the impeller travels at speeds up to 800 fps. The compression ratio for which a machine is designed varies considerably in modern practice, depending on the power delivered to the unit and the quantity of gas to be compressed. As shown in Fig. 3, single stage compressors may be designed for any point within a broad range of flow and pressure ratio. Multistage compressors are being seriously considered for low flows and high pressure ratios, but as yet have not been widely applied to pipe-line service.

Accessory Equipment

There are a number of accessories that are indispensable in the operation of centrifugal pipeline compressors. A motor driven or a mainshaft driven pump continuously circulates oil under pressure to all wearing parts. If the main pump fails to deliver the proper flow and pressure, an auxiliary pump, arranged to start automatically, maintains positive circulation. Indicating instruments are provided to show the pressure, temperature, and reservoir level of the oil at all times, and automatic alarm or shutdown devices usually are installed to detect any malfunctioning of the lubrication system.

Gas is prevented from escaping along the shaft as it emerges from the compressor case by an oil operated, differential pressure sealing system, as illustrated schematically in Fig. 4. The sealing oil pressure must be higher than the gas pressure and for this reason an elevated reservoir is provided to supply a head of oil during emergency periods when the seal oil pump is not operating. This emergency reservoir must be fitted with an automatic low level warning device which will allow ample time for the compressor to be stopped and blown down before the sealing oil is exhausted. Modifications in the control system and in the details of the seals have been used, but the basic principle of maintaining a chamber of oil between the compressor case and atmosphere is the same.

The basic variables which define the

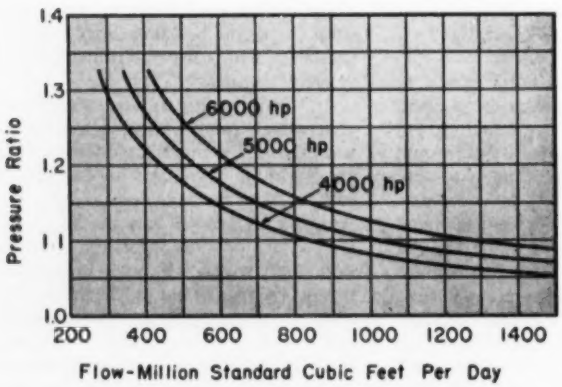


Fig. 3—Typical design range of single stage compressors.

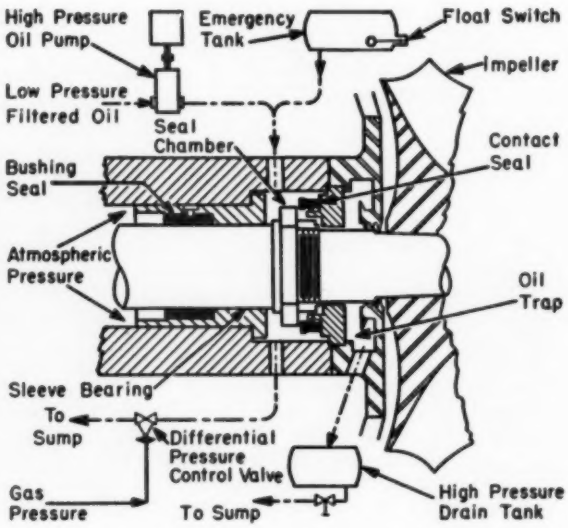


Fig. 4—Right, diagram of oil operated sealing system.

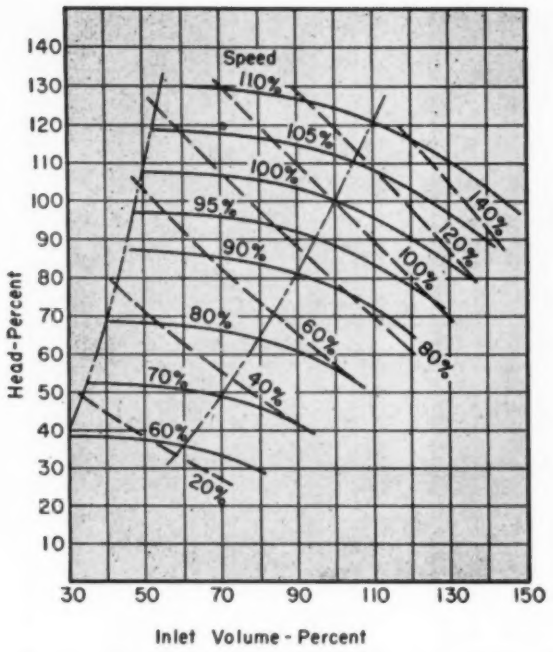


Fig. 5—Basic performance graph for a typical compressor.

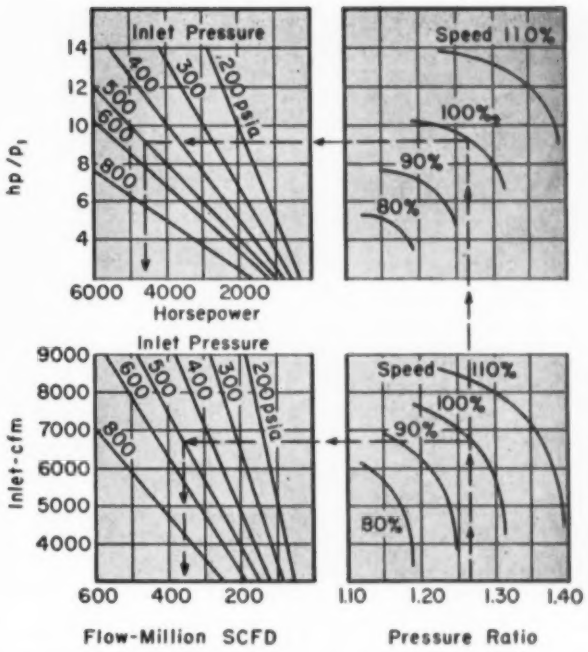


Fig. 6—Operating data for a specific compressor station.

performance of any centrifugal compressor are its blade speed, the actual volume of gas pumped, the head or work put into each pound of gas, and the efficiency of compression. Fig. 5 shows a basic performance graph for a typical compressor. Such a plot would be obtained from tests of the compressor and is applicable to any operating condition since pressure, temperature, specific gravity of the gas, and supercompressibility are eliminated from the variables used. Because information in these terms is of very little practical use outside the engineering office, a number of methods have been devised to transform these basic performance data into a useful form.

Performance Charts

One useful type of curve is illustrated in Fig. 6, where pressure ratio versus inlet volume is plotted for several speeds. The pressure ratio and speed, which may be readily determined from station gages, immediately locate the operating point. Having this point, the flow in standard cubic feet per day may be determined from the lower left section of the plot, and the horsepower from the upper left section of the plot. This curve is precise only at one specific inlet temperature and inlet pressure. Deviations are small, however, over the normal range of operating pressures and temperatures in most compressor stations, and the curve usually is adequate for operating purposes. If it is necessary to cover extreme operating conditions, additional curves can be calculated for both low and high pressure and low

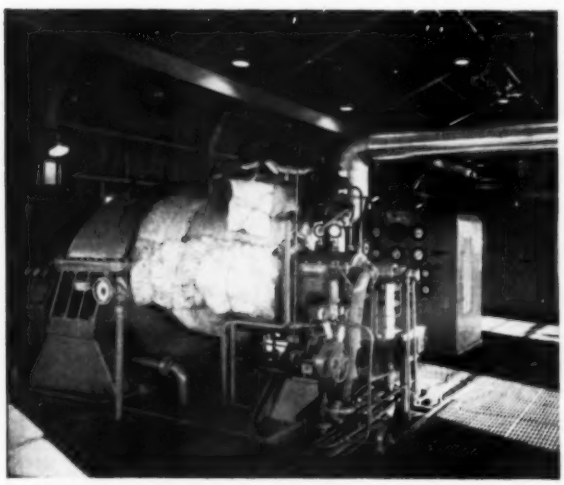


Photo shows 5000 hp multistage turbine driven compressor.

Unit is for high pressure natural gas transmission line.

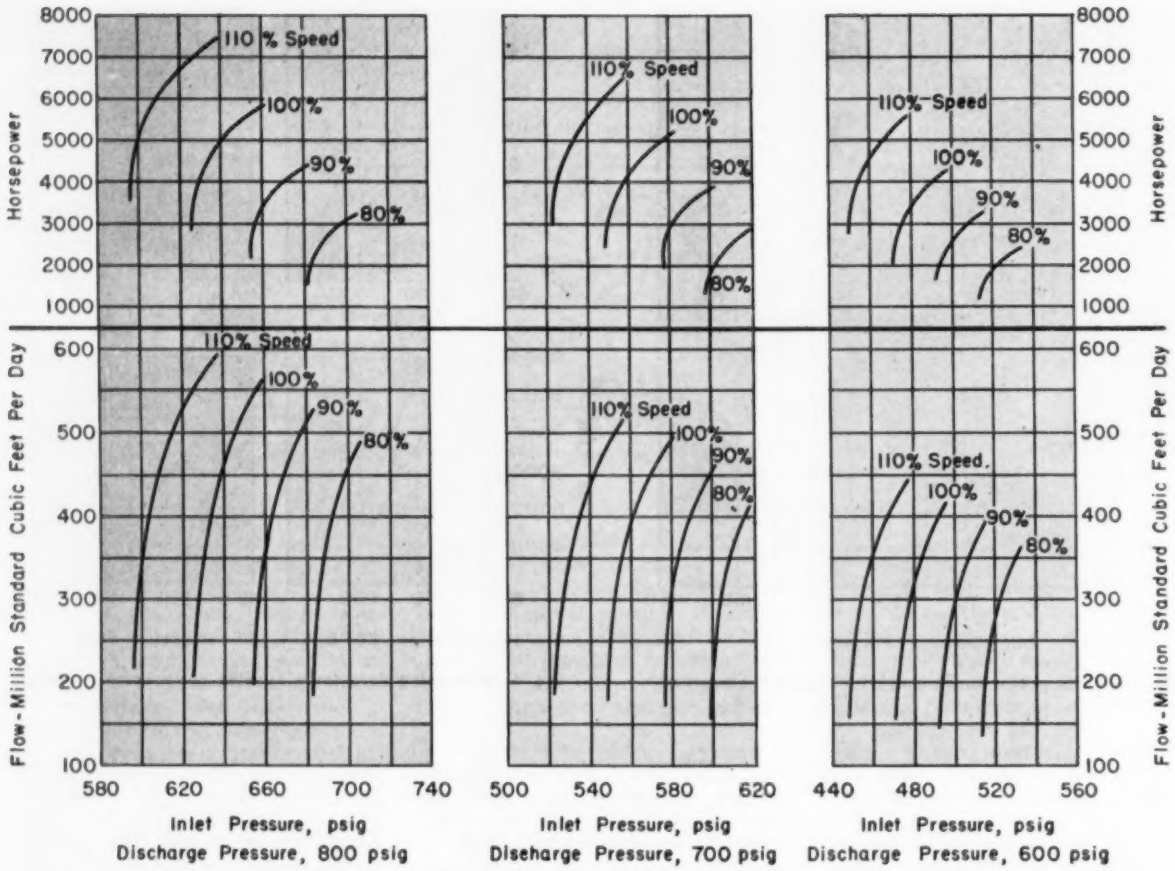


Fig. 7—Curves at various discharge pressures show performance data for the entire operating range of the compressor.

and high temperature conditions.

Another type of performance chart is illustrated in Fig. 7. Each curve is calculated for a specific discharge pressure, and the curves then show standard cubic feet per day and horsepower versus suction pressure for several speeds of the compressor. A large number of curves are prepared to cover, in small increments, the range of discharge pressure through which the compressor will operate.

It also may be necessary to plot a set of these curves for different inlet temperatures. Although this system results in a large number of curves for each machine or each station, it is necessary only to select the proper curve and read directly the horsepower and flow, thus avoiding the calculations necessary with curves similar to Fig. 6.

Multiple Unit Systems

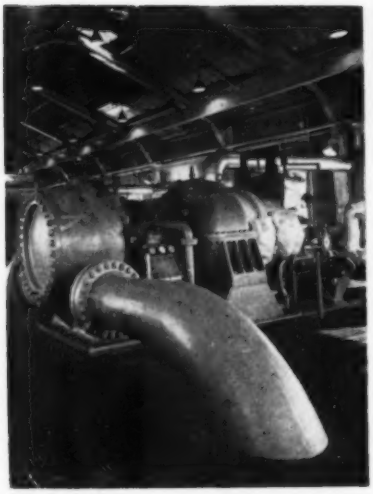
Many modern compressor stations have two, three, or four centrifugal compressor units arranged in series in order to obtain the desired station pressure ratio. Such an arrangement results in great flexibility of operation, as shown in Fig. 8. This curve presents a typical relationship between flow and station pressures, and illustrates how the three compressor units would be operated as the flow changes. It can be seen that at 100 per cent speed, two of the three compressors will carry over 90 per cent of the rated flow, and one compressor will carry over 80 per cent of the rated flow. If the compressors are overspeeded slightly, which is usually possible with turbine or engine drives, even larger percentages of the rated flow can be pumped with one or two compressor units shutdown.

Fig. 8 also reveals the fact that the compressor efficiency drops only slightly over the entire flow range except at the very low flow end of the curve. It is worth noting that to achieve this situation, each compressor must have a "flat" pressure ratio-flow characteristic. That is, the pressure ratio must decrease gradually as the flow increases. It is inherent that the total flow-pressure characteristic of a group of centrifugal compressors in series will be steeper than the characteristics of each individual compressor. Thus, it is desirable to design the individual compressors of such a series combination to have flat characteristics in order to avoid too steep a characteristic of the over-all combination.

Surging

Any centrifugal compressor or, for that matter, any compressor which accomplishes its compression by the dynamic action of moving blading, will exhibit a pressure-volume characteristic similar to that shown in Fig. 9. This chart demonstrates that the slope of the curves is always negative (pressure decreases with increasing volume) in the stable range and that instability, called "surging," occurs where the slope of the curves becomes positive.

When, at a given pressure ratio, the flow drops below the stable operating range of the compressor, the pressure suddenly falls and surging develops. The violence of the surging and its frequency depend on the design of the compressor and the size, length, and configuration of the attached piping. Surging usually causes



Heavy duty construction is required to satisfy severe service conditions.

Steel casings are easy to clean and improve the appearance of the plant.

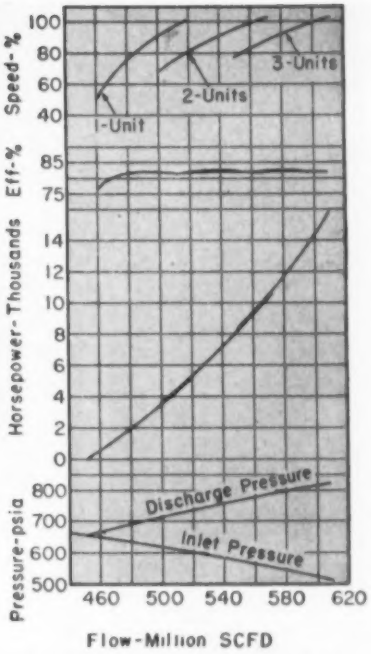


Fig. 8—Chart shows characteristics of a three unit compressor station.

considerable noise and commotion and is attended by fluctuations of some magnitude in the gas pressure and perhaps some vibration of the compressor. It is normally not destructive in pipeline compressors, but is to be avoided.

Centrifugal compressors are designed for maximum operating pressure and maximum flow of the pipeline. During periods of light load the flow often drops below the stable operating range of the compressor if the maximum line pressure is maintained. Since the compressor "sees" only actual volume, it is possible to maintain stable operation at reduced flows by lowering the pressure level of the line. Thus, if a compressor is designed for a trillion standard cubic feet of gas per day at 700 psig, the actual inlet volume would be approximately 13,000 cfm. If it were desired to pump only 60 per cent of this quantity, the same inlet volume of 13,000 cfm could be maintained by reducing the pressure to 430 psig. Then the compressor would still be operating at its design volume, although the power would, of course, be less. This is illustrated in Fig. 7, which shows flow and horsepower plotted against inlet pressure for the same compressor operating at different discharge pressures.

A somewhat different cause of surging in centrifugal pipeline compressors is too rapid reduction of speed. If the speed of the compressor is reduced rapidly, the compressor discharge pressure will fall more rapidly than the downstream line pressure. The compressor will be forced into surging operation until the downstream line pressure has bled down to the discharge pressure of the compressor. This situation can be avoided by reducing speed gradually. By the same reasoning, increasing the speed of the compressor tends to move the operating point further into the stable range, and it is not necessary to be so cautious with the rate of speed increase.

The centrifugal compressor is still relatively new to pipeline service. Its characteristics differ in several respects from those of the piston compressors heretofore employed for gas booster stations. In the hands of a skilled operator, it can be a valuable new tool in a rapidly growing industry.

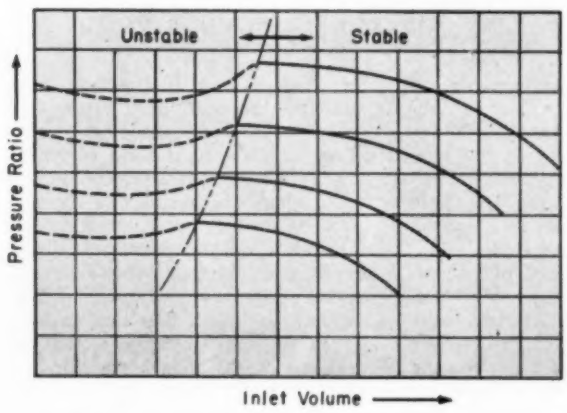
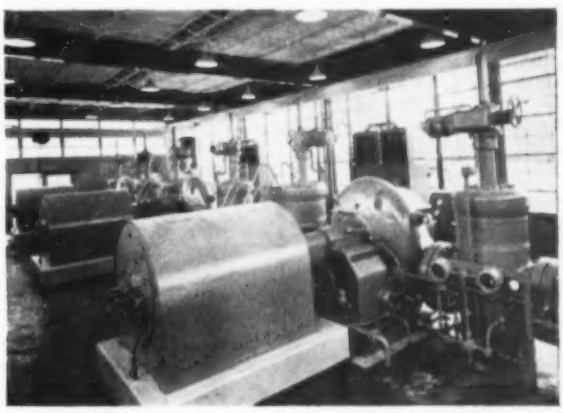
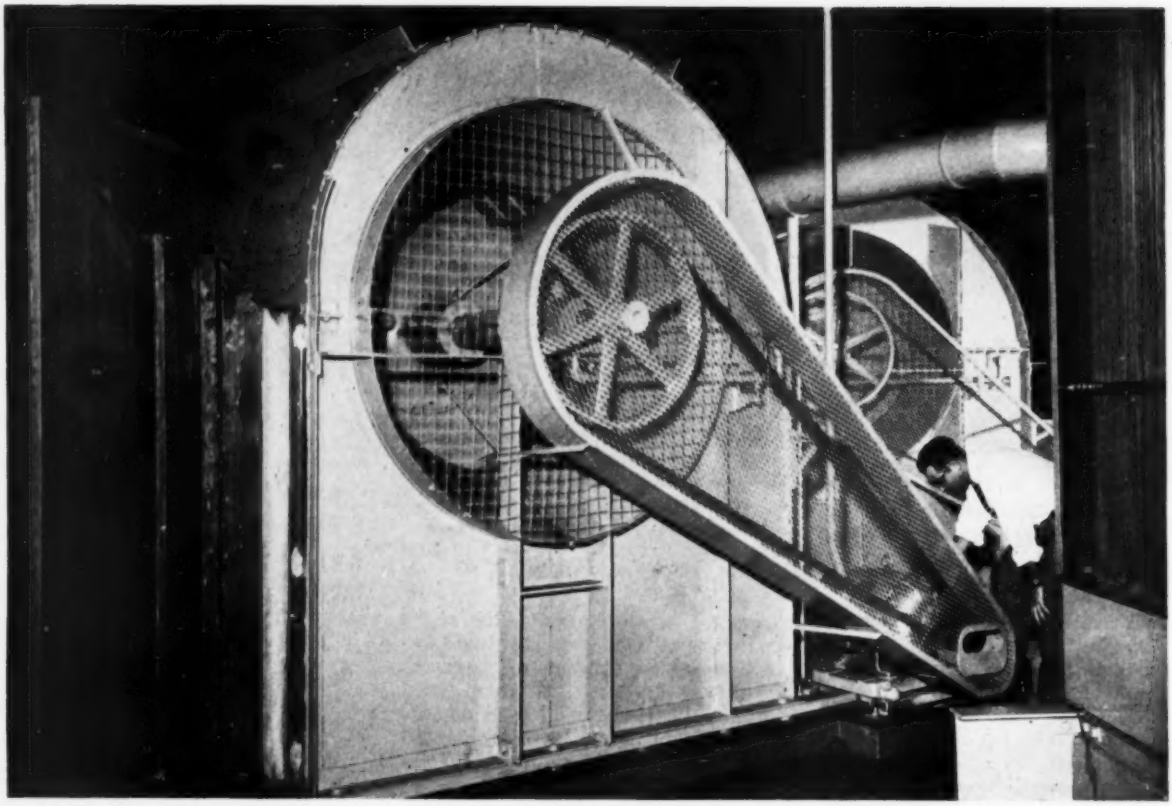


Fig. 9—Pressure-volume curves of centrifugal compressor indicate the operating points at which surging develops.



Most modern compressor stations have two or more units arranged in series to guarantee operational flexibility.



View of two, 52,000-cfm induced draft fans in downstream plenum chamber. Note copper moisture eliminators at right.

Reversed Washer Saves Water

Reversed air washer, used as indoor water cooling unit for air conditioning system, saves water and dollars for City Bank-Farmers Trust Building.

INDOOR REVERSED WASHERS are a neat solution to the problem of providing water cooling in buildings not designed to accommodate standard cooling towers. This problem has arisen in water shortage areas where legislation requires owners and operators to install systems which will permit continuous recirculation of cooling water.

An indoor reversed washer system was installed in the 56-story City Bank-Farmers Trust Building, New York City, during the severe water shortage of 1950. Performance data for August, 1951 showed a total water consumption by meter reading of 15,360 cu ft. This equals approximately 1.6 per cent makeup water, which is considerably better than the average cooling tower located outdoors. Based on 23 days of 10 hours each and a water circulation of 1200 gpm, the makeup water is about 1.4 per cent. Water savings for the first season of operation were over $5,000, including power for pumps and fans.

The system was designed by Guy B. Panero, Engineers, of New York City, working with the owner's architectural and engineering group.

Initially, the installation of a standard cooling tower was considered. However, the only sites available were the roof of an adjoining 12-story building, owned by the bank, and the 23rd floor set-back. Both were rejected because of appearance and, especially, the effect of moisture carryover on tenants. In New York City, this consideration is most important and failure to anticipate it has resulted in law suits against building owners.

An indoor system, using a reversed washer was finally decided upon as the method which best met the specific requirements. A reversed washer is merely a standard air washer, which, instead of cooling air, cools water and discharges the warm air resulting from the heat exchange. The unit was installed on the 15th floor, and was designed with enough capacity to serve a future 400 ton Freon centrifugal system which will eventually replace the existing equipment. Space limitations determined the selection of

a 2-stage reversed air washer of standard design and construction.

One feature of the installation is the use of air taken from a pipe space over the entire 15th floor as well as from windows. The pipe space is fully ventilated by wall openings around the building periphery. Since such a pipe space is utilized in many multi-story buildings, usually at the mid-point in the main building structure, this feature eliminated the need for excessive window openings at the 15th floor and thus reduced the required over-all floor space.

Moisture Protection

Moisture, in the form of carry-over and saturated air, is vitally important in the installation of an indoor washer and affects both equipment and building structure. All equipment is of standard metal construction as follows: steel washer basin, copper eliminators, galvanized steel inlet louvers, steel fans, copper ducts, cast iron pump casings and bases, and red brass piping inside of washer.

All steel and galvanized parts exposed to moist air downstream of the washer were provided with one or two coats of asphalt-base paint, either factory or field applied. In addition, the owner's engineer applied a final coat of fish oil paint on external parts of equipment downstream of the washer for additional protection.

The owner's architectural and engineering group planned the waterproofing and protection of walls, floors, and ceiling. This included a 5-ply membrane waterproofed floor with waterproof cement, trowel finished. The floor protection was extended on the walls to a height of 9 in. above floor level. No floor penetrations were permitted except for floor drains and overflow pipes.

Copper cladding protects the ceiling against any moisture carry-over.

Walls were finished with two coats of waterproof cement and the ceiling with a ½-in. trowelled coat of waterproof mastic, all painted with aluminum. Copper clad doors and tightly sealed and caulked windows and pipes provide full protection against an outward leakage of moisture.

Noise and Vibration

Because the washer room is directly above the bank library and is adjacent to the Translator Division, noise and vibration reduction was extremely important. The following means proved effective in keeping noise and vibration at an acceptable level:

1. Oversize fans with a speed of 360 rpm mounted on standard integral vibration bases.
2. Pump speed at 1750 rpm with both isolation rails and isolation base.
3. Double wall between the washer space and the Translator Division.

Savings Vs Space Cost

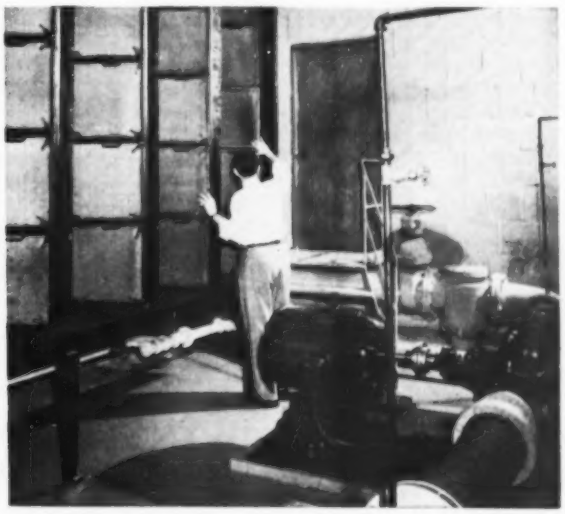
The entire washer installation, including the entrance corridor and starter panel, covers an area of 1400 sq ft, or 3.5 sq ft per ton of capacity. With a less elaborate installation and better space shape available, it is believed that space utilization can be cut down to approximately 3 sq ft per ton. In general, the rent value of such space must be balanced against the savings gained by the use of this system. In the present case, the alternate system requiring the use of cooling towers, even if it were possible, would have required a much greater expenditure for piping, structural reinforcement and electric power lines.

The total approximate cost of the present installation was equal to $250 per ton including all piping and construction cost. Electric power already available kept the cost down, but with such service included, the estimated cost is $280 per ton of capacity.

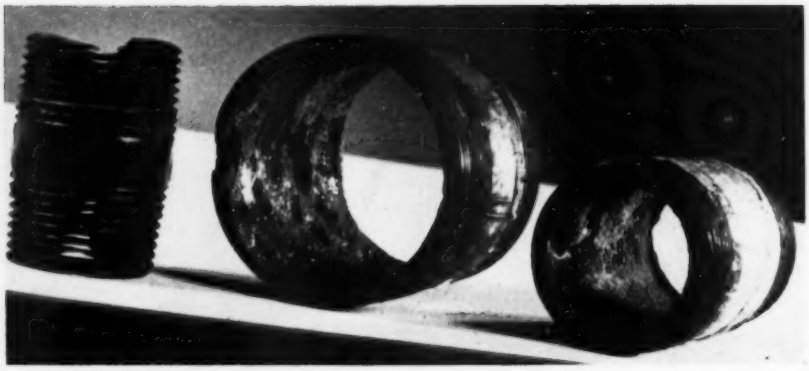
The reversed washer, fans, and related equipment, were supplied by the Clarage Fan Company.

The building management is satisfied with the reversed washer installation in that it has performed well and maintenance costs have been reasonable.

First stage of reversed washer shows banks of spray heads with copper moisture eliminators at extreme left.



Air intake filters on dry side of second stage of washer. At right is the second stage centrifugal pump installation.



Effects of corrosion as shown at right include grooving (especially at thin sections such as threaded joints), pitting, and deposits.

Corrosion in Condensate Return Systems

J. L. THORNLEY, *Chief Laboratory Supervisor*
The Bird-Archer Company

CORROSION in condensate return systems causes leakage, plugging of pipes, and failure of check valves and traps. It interferes with production and frequently damages manufactured goods and property. Because corrosive action has a high nuisance value, its effect cannot be ignored and replacements and repairs are essential.

The effects of corrosion are widespread for the agents which cause it are found everywhere in nature. One estimate states that 20 per cent of all metal processed is intended as replacement for some that has been rendered useless by corrosion. Another estimate states that the cost of corrosion for the United States alone is 5½ billion dollars yearly. This staggering sum is divided into three parts: (a) metal replacement, (b) labor costs, and (c) inhibitors.

In general, corrosion is defined as the chemical alteration of metal. It also might be defined as the conversion of dense, well-formed steel into a light, powdery, useless rust.

The theory of corrosion is exceedingly complex but when reduced to simple terms it states that iron possesses the ability to displace hydrogen from acids, and since water can be considered an acid, although a very weak one, iron can displace hydrogen from water. This is an electrochemical reaction in that atoms of a metal tend to ionize. They lose their identity as solid metal and become positively charged particles. In so doing, they release negative electrons to hydrogen ions already present in the water. The hydrogen deionizes (forming bubbles of hydrogen gas or combining with oxygen also present in the system) to reform water. Continuation of this electrochemical process causes metal loss.

The physical fact that iron is found

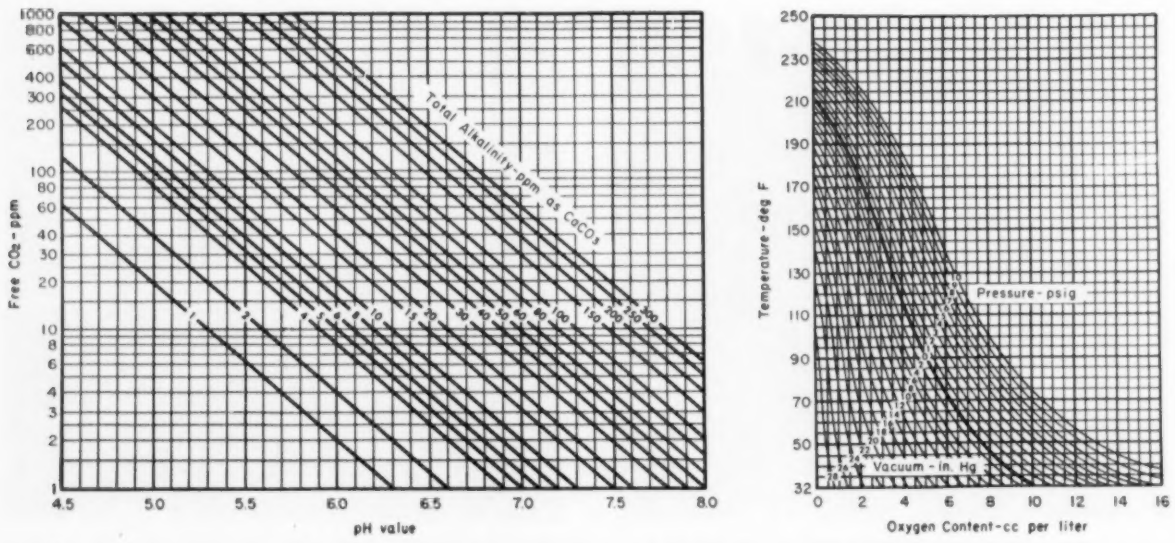
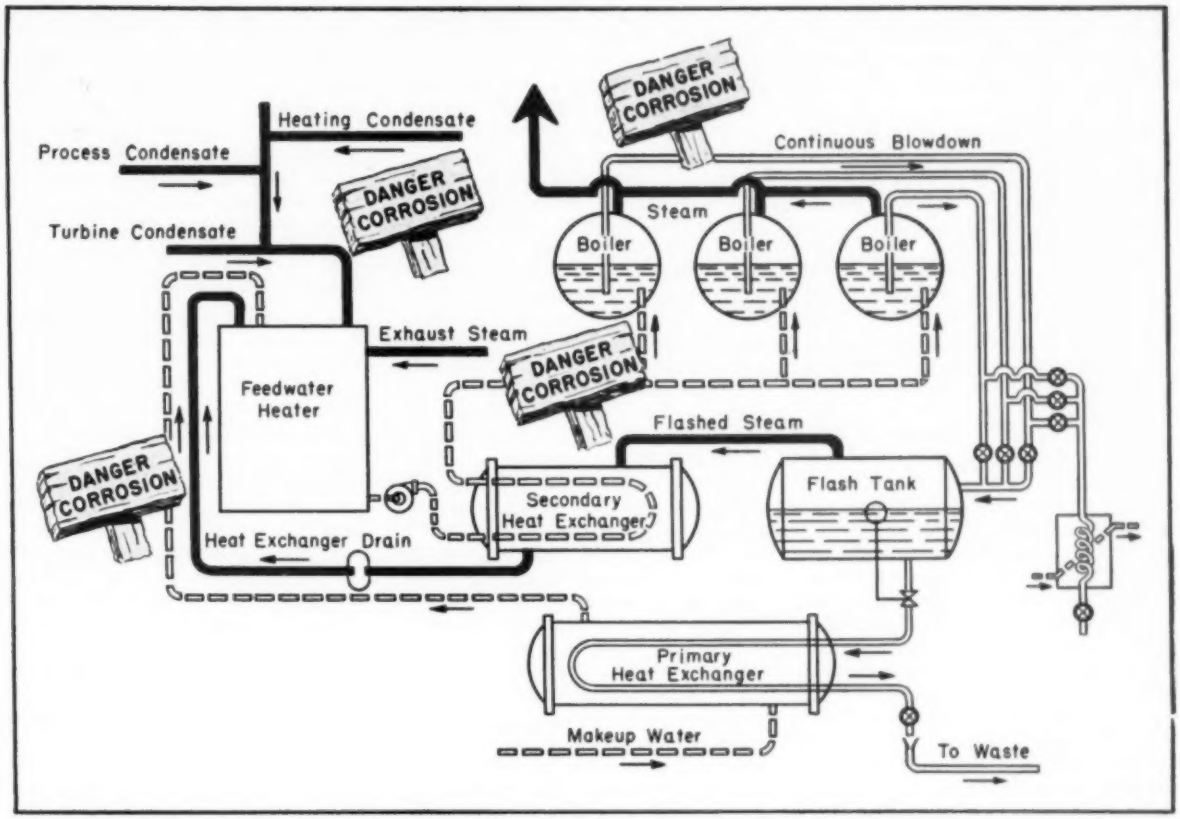


Chart shows approximate relationships of free CO_2, pH, and alkalinity, left, and the solubility of oxygen in water, right.



Schematic diagram of typical steam plant reveals points in the system which are most vulnerable to corrosion attacks.

most abundantly in nature as an oxide indicates its corrosive tendencies. After iron ore is processed to produce the metal, the forces of nature set to work to undo this tampering, and a reversion to an oxide, the most stable form of iron, results. Contrast this with gold, which is found principally as a metal, and after being formed into a compound, it is easily reduced again.

Influencing Factors

Some of the agents and conditions which cause or influence corrosion in condensate return systems are:

(1) Dissolved gases, including oxygen, carbon dioxide, and possibly sulfur dioxide and hydrogen sulfide.

(2) Electrolytic solutions, formed by carryover of untreated boiler water.

(3) Galvanic cells, caused by dissimilar metals such as brass, bronze, or copper in contact with steel in the presence of water, or impurities or alloying substances in the metal.

(4) Velocity, as high velocity brings a larger volume of water and corroding agents into contact with metal.

(5) Stray currents, an unusual but possible condition.

(6) Temperature, with the higher temperatures accelerating corrosion.

The action of dissolved gases is of greatest importance since it is the chief cause of corrosion in condensate systems. Oxygen and carbon dioxide which are present in natural waters are the principal offenders and unless removed in the feedwater heater will pass over with the steam. In addition, bicarbonates of calcium and magnesium when heated are converted to normal carbonates with the liberation of carbon dioxide. Also, soda ash breaks down under the influence of boiler temperature and pressure into caustic soda and carbon dioxide.

In order to understand the role of oxygen and carbon dioxide in corrosion, a review of the electrochemical nature of corrosion is necessary. Pure water has very little effect on pure iron but this situation is seldom encountered. Under most conditions, there is a tendency for iron to dissolve in water, and two electrons are released for each atom that dissolves. These electrons are transferred to hydrogen ions present in water, and the ions are reduced to elemental gaseous hydrogen. All action ceases at this point if the hydrogen remains on the surface of the metal since a protective coating is formed that interferes with the passage of electrons. However, any agent which increases the number of hydrogen ions present in the water or which will cause the removal of the hydrogen film, serves to increase the rate of corrosion.

When carbon dioxide dissolves, it reacts with water to form carbonic acid, which supplies additional active hydrogen to the system. Iron hastens to displace the hydrogen from this acid. When oxygen is also present in the water, a two-fold reaction takes place. Some molecules of oxygen combine with the displaced hydrogen to reform water, and thus expose the metal to fresh attack. Other oxygen particles combine with iron ions to form insoluble rust compounds.

Effect of Impurities

A greater corroding influence than the mere dissolving tendency of iron is the existence of a heterogeneous surface in commercial iron and steel. The metal contains impurities or alloying substances which tend to segregate. The segregated particles, which are usually more resistant to corrosion than iron, form couples with the adjacent iron particles. A couple is formed when two dissimilar metals are in contact with one another in a solution. For ex-

ample, when copper is placed in a dilute hydrochloric acid solution, there is no action. Now, if zinc is placed in the same solution, there is action due to the dissolving of zinc and the formation of hydrogen gas. However, the action is relatively slow because of the impeding effect of the bubble film.

If both metals are placed in the solution and connected by a wire, more rapid dissolution of the zinc takes place because the electrons travel through the wire and are transferred to hydrogen ions on the surface of the copper. This same reaction occurs on the surface of commercial iron and steel. Particles of iron dissolve and release electrons to hydrogen ions on the surface of adjacent impurities, thus increasing the corroding area. The couple action results in a rapid removal of the hydrogen film and therefore accelerates the rate of corrosion.

The first product of corrosion may be converted to ferric oxide, which is only loosely adherent and aggravates corrosion by blocking off areas to oxygen access. These areas become positively charged, and iron—iron oxide couples are set up. The iron under the oxide deposit then dissolves, and pitting develops. Carbon dioxide attack, on the other hand, results in thinning or grooving of the metal. The effect is especially noticeable at thin points such as at threaded joints.

Prevention of Corrosion

Since carbon dioxide is chiefly responsible for corrosion in return systems, measures should be taken to reduce the bicarbonate and carbonate content of the feedwater. The feedwater heater efficiency should be checked regularly to ascertain if it is operating at the proper temperature and venting oxygen and carbon dioxide. When a lime-soda softener is employed, a hydroxide excess should be maintained to eliminate bicarbonate. If ion exchange softening is feasible, both hydrogen and sodium cycles are advisable to remove all carbonate.

When all possible external means of reducing or preventing corrosion are insufficient and it is not feasible to eliminate sources of carbon dioxide completely, internal treatment can be employed. An effective agent for this purpose is one that will increase the hydroxide concentration of the water since the solution rate of iron is lowest at a pH value of 9.6 or above. Since carbon dioxide and water form carbonic acid, the agent must have an affinity for carbon dioxide so it can neutralize the acid characteristics. This can be accomplished by ammonia, ammonium compounds, and amines (organic ammonia compounds).

Ammonia is a gas which is very soluble in water. It is exceedingly volatile and when injected into a boiler will pass over with the steam and carbon dioxide. As the steam condenses, the ammonia combines with the carbon dioxide to form ammonium carbonate. Additional ammonia combines with water to form ammonium hydroxide, which is alkaline. Increased alkalinity reduces the hydrogen ion concentration, thus neutralizing one of the agents which cause corrosion.

Ammonium compounds such as ammonium sulfate, chloride, or phosphate prevent corrosion in exactly the same manner. However, caustic soda is required to release the ammonia gas from the compounds. The sodium in caustic soda displaces the ammonia.

Neutralizing amines are nitrogen containing organic bases which do not contain or ordinarily liberate free ammonia in boiler systems. They vaporize with the steam and condense with the water, and their action in preventing corrosion is to neutralize carbon dioxide by forming an amine carbonate.

One common amine is cyclohexylamine, $C_6H_{13}N$. This is a colorless liquid, lighter than water, but only slightly soluble in water. Its boiling point is 275 F, but when added to water it forms a mixture that boils at a lower temperature than water itself. It, therefore, volatilizes very easily from boiling water and when slug fed will quickly concentrate in the steam. It ionizes to a greater extent than ammonia, and consequently produces quite alkaline solutions with high neutralizing power.

Another amine, morpholine (C_4H_9ON), is a colorless, hygroscopic, oily liquid, which is about as heavy as water and completely miscible with water. Its boiling point is 262 F, but at atmospheric pressure a boiling water solution will contain about two parts of morpholine to one part in the steam. Thus, morpholine does not vaporize as readily as cyclohexylamine. However, both cyclohexylamine and morpholine effectively inhibit corrosion.

Methods of Feeding Treatments

Ammonia is shipped as liquid ammonium hydroxide—26 deg Be′ and should be diluted 1 part with 3 parts water. It is most conveniently fed through a proportioning pump or by pouring into a funnel on the suction side of the feedwater pump.

Ammonium compounds are dry materials and can be slug fed separately or together with the regular boiler water treatment. Also, they can be dissolved in water and fed continuously.

Cyclohexylamine can be slug fed into a bypass feeder on the discharge side of the feed pump or on the suction side of the condensate pump. It also can be fed continuously to the steam or condensate lines.

Morpholine can be fed into the boiler, steam lines, or condensate lines periodically or continuously by a chemical feed pump. The most convenient arrangement is to feed either on the suction or discharge side of the feedwater pump. If slug fed, several doses should be used daily rather than a single application.

Relative Characteristics

Ammonia as ammonium hydroxide is an inexpensive liquid, the use of which is restricted because of the intensely pungent, irritating odor and its attacks on copper, brass, and bronze. Sometimes recommended for large installations that can bear the initial equipment cost, ammonia has the distinct advantage of being inexpensive once equipment cost is written off.

Since ammonium compounds are dry materials, they are easy to handle. However, caustic soda is required to release the ammonia and this liberation reaction results in an increase in total dissolved solids in the boiler water. This will increase the blowdown.

Cyclohexylamine, because of its great volatility, quickly passes into the condensate which reduces blowdown losses. However, if the condensate is then passed through a heater, the vent losses will be considerable. Thus, cyclohexylamine usually is restricted to low pressure systems with long distribution lines or to reduced pressure systems where an amine of lower volatility would condense and be discharged.

Cyclohexylamine has a greater affinity for acids than ammonia. With dissolved carbon dioxide it forms very stable cyclohexylamine carbonate. When the feedwater containing this compound passes through the heater, the amine carbonate does not tend to decompose by heat, but tends to concentrate in the boiler. Here, however, it encounters the sodium ion which displaces the amine; sodium carbonate is formed, and eventually carbon dioxide is released again.

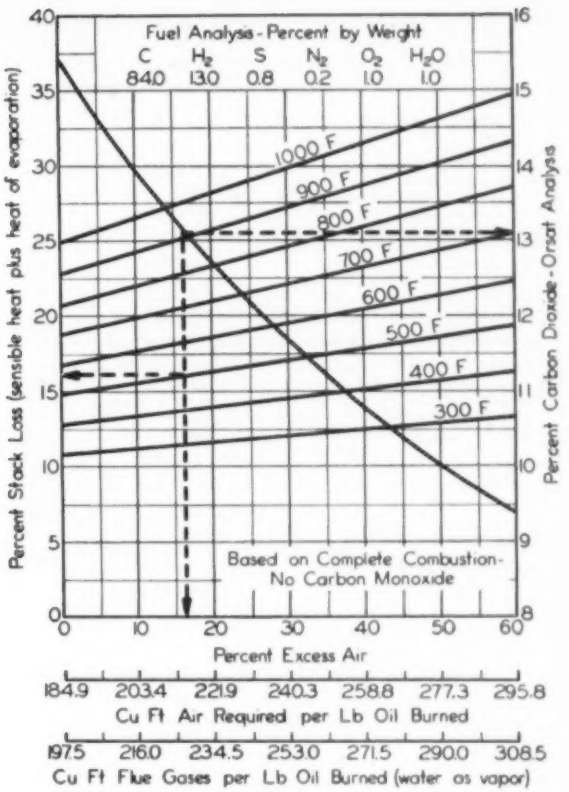
Morpholine will not excessively raise the pH of a system and has a distinct advantage over ammonia in that it is hard to overtreat water with too heavy a dose. Therefore, close control is not necessary. It is superior to cyclohexylamine in that its carbonate decomposes more readily, and the carbon dioxide discharges at the heater. Also, its lower volatility in the free state results in lower vent losses.

Amines are more expensive than ammonia, but are more easily handled and in concentrations up to 1000 ppm do not attack nonferrous metals. Test results and field experience have proven that amines effectively inhibit corrosion.

Interpreting Stack Losses

Stack losses are major factors affecting boiler efficiency. These graphs give combustion efficiency based on your Orsat analysis and flue gas temperature readings.

JOHN B. HARJU
Professional Chemical and Mechanical Engineer
Ferndale, Michigan


Fuel Analysis - Percent by Weight
C H2 S N2 O2 H2O
84.0 13.0 0.8 0.2 1.0 1.0
1000 F
900 F
800 F
700 F
600 F
500 F
400 F
300 F
Based on Complete Combustion-
No Carbon Monoxide
Percent Stack Loss (sensible heat plus heat of evaporation)
Percent Carbon Dioxide - Orsat Analysis
Percent Excess Air
184.9 203.4 221.9 240.3 258.8 277.3 295.8
Cu Ft Air Required per Lb Oil Burned
197.5 216.0 234.5 253.0 271.5 290.0 308.5
Cu Ft Flue Gases per Lb Oil Burned (water as vapor)

Stack losses when firing light oil of stated analysis.

ALTHOUGH FUEL COSTS in most combustion processes represent only a small fraction of total manufacturing or operating expense, steadily rising prices have encouraged more efficient utilization of fuel.

In all combustion processes, the largest single item of heat loss affecting operating economy is that incurred in the stack gases. It is quite obvious that stack losses increase with increasing flue gas temperatures and also with the amount of flue products. Thus, the relationship between stack losses and the amount of flue gases at various flue gas temperatures has been developed for typical firing conditions.

Rapid interpretation of stack losses occurring in such low temperature combustion applications as space heating and process steam production is facilitated by the use of the graphs. Only an Orsat analysis (direct measurement of flue gas products is impractical) and a flue gas temperature reading are required to obtain combustion efficiency. The graphs are for installations using light oil, heavy oil, and natural gas fuels and assume complete combustion of carbon, hydrogen, or compounds of the two to carbon dioxide and water.

When preparing the graphs, light and heavy oil analyses in percent by weight were obtained from *Perry's Chemical Engineers Handbook,* and a typical natural gas analysis in percent by volume was obtained from the periodic reports of the Panhandle Eastern Pipeline Company. These fuel compositions are as follows:

Light oil

Component	Symbol	Percent by weight
Carbon	C	84.0
Hydrogen	H_2	13.0
Sulfur	S	0.8
Nitrogen	N_2	0.2
Oxygen	O_2	1.0
Water	H_2O	1.0
		100.0

Heavy oil

Component	Symbol	Percent by weight
Carbon	C	86.0
Hydrogen	H_2	11.0
Sulfur	S	0.8
Nitrogen	N_2	0.2
Oxygen	O_2	1.0
Water	H_2O	1.0
		100.0

Natural gas

Component	Symbol	Percent by Volume
Methane	CH_4	81.3
Ethane	C_2H_6	11.1
Nitrogen	N_2	7.0
Oxygen	O_2	0.4
Carbon dioxide	CO_2	0.2
		100.0

Computations involved in the development of the graph showing stack losses incurred when firing light oil are shown in Table 1. Although these calculations are based on the complete combustion of 100 lb of light oil with analysis as indicated above, they will serve as a guide for engineers who wish to prepare additional charts for other fuel analyses. For simplicity, the procedure is divided into several parts marked "A" to "E" inclusive.

Description of Calculations

Certain known data are required for the calculations including the relative molecular weights of the various elements which enter into the combustion reaction. These are as follows:

Element	Symbol	Molecular weight
Carbon	C	12
Hydrogen	H_2	2
Sulfur	S	32
Nitrogen	N_2	28
Oxygen	O_2	32

The computations assume air is 79 percent nitrogen and 21 percent oxygen by volume and use a value of 379 for the pound molecular volume at atmospheric pressure and a temperature of 60 F.

Parts "A" and "B" indicate the methods for determining oxygen requirements for combustion and the resulting flue gas product volumes. A tabulation of the flue gas products at various excess air percentages also is

TABLE 1 — CALCULATION PROCEDURE FOR DETERMINING STACK LOSSES
Based on complete combustion (no carbon monoxide) of 100 lb of light oil

A. Oxygen Requirements for Perfect Combustion (no excess air)

O_2 for carbon — $C + O_2 = CO_2$: $12 + 32 = 44$	
84 lb carbon requires $(84 \times 32 \times 379) \div (12 \times 32) =$	2653.00 cu ft
O_2 for hydrogen — $H_2 + \frac{1}{2}O_2 = H_2O$: $2 + 16 = 18$	
13 lb hydrogen requires $(13 \times 16 \times 379) \div (2 \times 32) =$	1231.75 cu ft
O_2 for sulfur — $S + O_2 = SO_2$: $32 + 32 = 64$	
0.8 lb sulfur requires $(0.8 \times 32 \times 379) \div (32 \times 32) =$	9.47 cu ft
O_2 for carbon, hydrogen, and sulfur	3894.22 cu ft
O_2 already in oil $= (1.0 \times 379) \div 32 =$	11.80 cu ft
O_2 to be supplied from air	3882.42 cu ft
N_2 inclusion from air $= (3882.42 \times 79) \div 21 =$	14605.41 cu ft
Volume of air required for perfect combustion	18487.83 cu ft

B. Flue Gas Products Resulting from Perfect Combustion

From carbon—84 lb produces $(84 \times 44 \times 379) \div (12 \times 44) =$		2653.00 cu ft CO_2
From hydrogen—13 lb produces $(13 \times 18 \times 379) \div (2 \times 18) =$	2463.50 cu ft	
From water in oil—1 lb produces $(1.0 \times 379) \div 18 =$	21.05 cu ft	2484.55 cu ft H_2O
From sulfur—0.8 lb produces $(0.8 \times 64 \times 379) \div (32 \times 64) =$		9.47 cu ft SO_2
From nitrogen—N_2 from combustion air (see part A)	14605.41 cu ft	
N_2 from oil $= (0.2 \times 379) \div 28 =$	2.70 cu ft	14608.11 cu ft N_2
Total volume of flue gas products		19755.13 cu ft
Percent CO_2 — Orsat or dry basis $= (2653 \times 100) \div (19755.13 - 2484.55) =$		15.36 percent

Flue Gas Products with 10 Percent Excess Air

O_2 — 10 percent excess air $= 3882.42 \times .10 =$		388.25 cu ft
N_2 from excess air $= (388.25 \times 79) \div 21 = 1460.54$ cu ft		
N_2 from combustion air and oil	14608.11 cu ft	16068.65 cu ft
H_2O vapor		2484.55 cu ft
CO_2		2653.00 cu ft
SO_2		9.47 cu ft
Total volume of flue gases with 10 percent excess air		21603.92 cu ft
Percent CO_2 — Orsat or dry basis $= (2653 \times 100) \div (21603.92 - 2484.55) =$		13.88 percent

The volume of flue gas products for other excess air conditions are as follows:

Percent excess air	20	30	40	50	60
O_2-cu ft	776.49	1164.74	1552.97	1941.21	2329.45
N_2-cu ft	17529.19	18989.75	20450.28	21910.83	23371.35
CO_2-cu ft	2653.00	2653.00	2653.00	2653.00	2653.00
H_2O-cu ft	2484.55	2484.55	2484.55	2484.55	2484.55
SO_2-cu ft	9.47	9.47	9.47	9.47	9.47
Total cu ft	23452.70	25301.51	27150.27	28999.06	30847.82
Percent CO_2-dry basis	12.65	11.63	10.76	10.01	9.35

C. Stack Gas Heat Losses at 300 F with Perfect Combustion

Flue gas products	*Volume cu ft*	*Moles cu ft/379*	*Sensible heat Btu per lb-mole*	*Total sensible heat — Btu*
N_2	14608.11	38.54	1678.1	64673.97
CO_2	2653.00	7.00	2274.8	15923.60
H_2O	2484.55	6.55	2026.7	13274.89
SO_2	9.47	.03	2274.8	68.24
Total sensible heat in stack gases				93940.70 Btu
Heat of evaporation of water $= 2484.55 \times 50.3 =$				124972.78 Btu
Total stack loss with flue products at 300 F				218913.57 Btu

D. Heat of Combustion

Fuel component	*Lb - moles Wt/mol. wt*	*Molal heat Btu per lb - mole**	*Total heat combustion*
C	$84/12 = 7.00$	97000×1.8	1,222,200 Btu
H_2	$13/2 = 6.50$	68300×1.8	799,110 Btu
S	$0.8/32 = .03$	69300×1.8	3,742 Btu
Heat of combustion (H_2O condensed)*			2,025,052 Btu

E. Percent Stack Loss

(Total stack loss $\times$ 100) $\div$ (Heat of combustion) $= (218{,}913.57 \times 100) \div 2{,}025{,}052 = 10.81$ percent

Stack Losses at Various Temperatures with Perfect Combustion

Temperature, deg F		400	500	600	700	800	900	1000
Gas	*Lb moles*	←		*Total sensible heat*				→
N_2	38.54	91879	119238	146764	174447	202295	230315	258503
CO_2	7.00	22865	29982	37270	44727	52348	60130	68070
H_2O	6.55	18881	24539	30255	36034	41881	47801	53801
SO_2	.03	97	128	159	191	224	257	291
Total sensible heat		133722	173887	214448	255399	296748	338503	380665
Heat of evaporation		124973	124973	124973	124973	124973	124973	124973
Total stack loss		258695	298860	339421	380372	421721	463476	505638
Percent stack loss		12.78	14.81	16.76	18.78	20.82	22.89	24.97

Stack Losses at Various Temperatures with 60 Percent Excess Air

Temperature, deg F		300	400	500	600	700	800	900
Gas	*Lb moles*	←		*Total sensible heat*				→
N_2	61.67	103488	147021	190800	234845	279143	323705	368539
O_2	6.15	10320	14661	19027	23419	27837	32281	36752
CO_2	7.00	15923	22865	29982	37270	44727	52348	60130
H_2O	6.55	13274	18881	24539	30255	36034	41881	47801
SO_2	.03	68	97	128	159	191	224	257
Total sensible heat		143073	203525	264476	325948	387932	450439	513479
Heat of evaporation		124973	124973	124973	124973	124973	124973	124973
Total stack loss		268046	328498	389449	450921	512905	575412	638452
Percent stack loss		13.24	16.22	19.23	22.22	25.43	28.42	31.48

included. These data were used to plot the curve showing relationship of CO_2 (dry basis) to percent excess air.

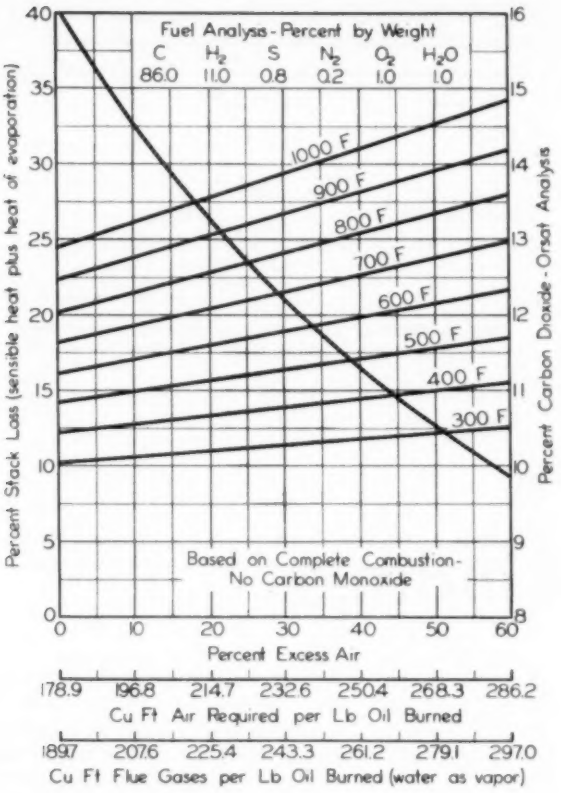
Stack gas heat losses from any combustion process consist of the summation of the sensible heat contents of each flue gas product plus the heat of evaporation of water formed by the combustion of hydrogen or hydrogen containing compounds in the fuel. Part "C" of the calculations shows the magnitude of these losses for perfect combustion of 100 lb of light oil when the flue products are at 300 F. When developing these values, the sensible molal heat contents of gases at high temperatures were obtained from a tabulation prepared by C. C. DeWitt, Michigan State College, Lansing, Michigan for *Chemical and Metallurgical Engineering*, June 1935.

Part "D" summarizes the procedure for determining the total heat of combustion for the various fuel components. The molal heat values listed are given in centigrade heat units per pound mole. One centigrade heat unit is the amount of heat required to raise one pound of water one degree centigrade. Since one degree centigrade equals 1.8 F, the centigrade heat units must be multiplied by 1.8 to convert the values to Btu per pound mole.

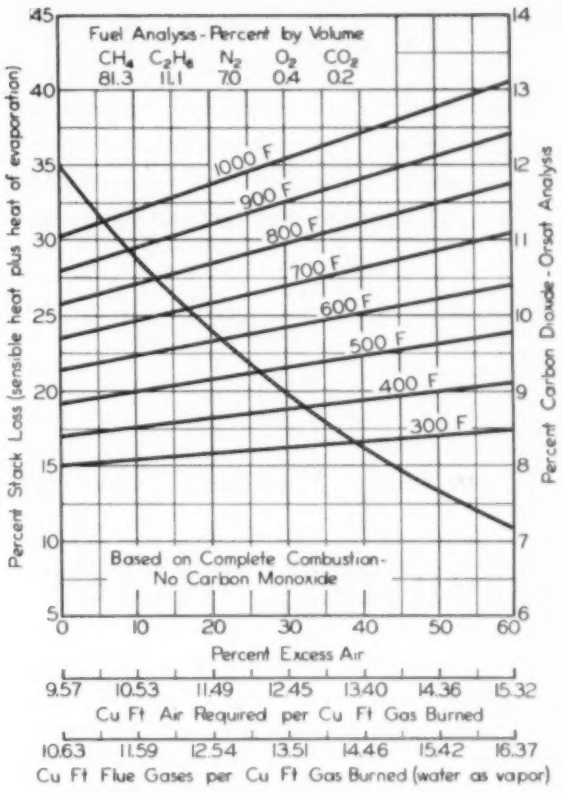
With both total heat loss and total heat of combustion established, the percent stack loss is readily calculated by direct ratio as shown in Part "E". For the selected example, the stack loss is 10.81 percent. Using the methods shown in Parts "C", "D" and "E", other stack loss percentages were computed for various gas temperatures with both zero and 60 percent excess air. These data were tabulated and used to plot the curves which are used with the curve showing CO_2 — excess air relationship to indicate percent stack losses.

Use of the Curves

An example to illustrate use of the curves is plotted on the graph showing stack losses with light oil firing. This assumed condition is 13.1 percent CO_2 by Orsat analysis at a stack gas temperature of 500 F. To use the curves, extend the point indicating 13.1 percent CO_2 horizontally to the curved line. Then extend the intersection of these lines vertically to the excess air line and read 16.2 percent excess air. From the intersection of this vertical line and the 500 F stack temperature curve, draw a line horizontally to the percent stack loss scale and read 16.0 percent stack loss, or 84.0 percent combustion efficiency. In addition, the air volume required and the flue gas volume produced per pound of oil burned can be obtained by interpolation at the base of the vertical line. These respective


Fuel Analysis - Percent by Weight
C H2 S N2 O2 H2O
86.0 11.0 0.8 0.2 1.0 1.0
1000 F
900 F
800 F
700 F
600 F
500 F
400 F
300 F
Based on Complete Combustion - No Carbon Monoxide
Percent Stack Loss (sensible heat plus heat of evaporation)
Percent Carbon Dioxide - Orsat Analysis
Percent Excess Air
178.9 196.8 214.7 232.6 250.4 268.3 286.2
Cu Ft Air Required per Lb Oil Burned
189.7 207.6 225.4 243.3 261.2 279.1 297.0
Cu Ft Flue Gases per Lb Oil Burned (water as vapor)

Stack losses when firing heavy oil of stated analysis.


Fuel Analysis - Percent by Volume
CH4 C2H6 N2 O2 CO2
81.3 11.1 7.0 0.4 0.2
1000 F
900 F
800 F
700 F
600 F
500 F
400 F
300 F
Based on Complete Combustion - No Carbon Monoxide
Percent Stack Loss (sensible heat plus heat of evaporation)
Percent Carbon Dioxide - Orsat Analysis
Percent Excess Air
9.57 10.53 11.49 12.45 13.40 14.36 15.32
Cu Ft Air Required per Cu Ft Gas Burned
10.63 11.59 12.54 13.51 14.46 15.42 16.37
Cu Ft Flue Gases per Cu Ft Gas Burned (water as vapor)

Stack losses when firing natural gas of stated analysis.

values are 215.0 and 227.6 for the selected example.

Effect of Nitrogen

It is interesting to note how large a part nitrogen plays in the stack losses of all combustion processes. This point is well illustrated by the following figures from the computations for burning light oil at perfect combustion and 60 percent excess air conditions.

With perfect combustion

Gas temperature, deg F	300	900
Sensible heat in flue gases due to N_2, Btu	64674	230315
Total stack loss, Btu	218914	463476
Percent of total loss due to N_2 sensible heat	29.4	49.5

With 60 percent excess air

Gas temperature, deg F	300	900
Sensible heat in flue gases due to N_2, Btu	103488	368539
Total stack loss, Btu	268046	638452
Percent of total loss due to N_2 sensible heat	38.4	57.5

Suggestive measures for controlling excess air to reduce sensible heat losses due to nitrogen are:

1. Draft control. Furnace draft should be limited to the value required to produce rated output of any furnace or boiler. In many cases, higher drafts than necessary are used to satisfy the vacuum conditions in the boiler room. This situation is due principally to the operation of the boiler itself as shown by the following example.

A burner input of 100 lb of light oil per hour corresponds to the operation of a 40 horsepower boiler. The cubage of a normal boiler room for a unit of this size is approximately 3600 cu ft. The air required (see graph for light oil) for burning 100 lb of light oil per hour with 30 percent excess air amounts to 240.3 x 100 or 24,030 cu ft per hour. This would necessitate the replacement of furnace room air at the rate of 6.6 times per hour. Without any outside louvers or wall openings, it can be readily seen why vacuum conditions in furnace rooms necessitate higher drafts than those actually required for combustion.

2. Elimination of leakage. All excess air above that necessary to obtain complete combustion serves to lower furnace efficiencies by lowering the flame temperature of the combustion process and by increasing the heat losses due to stack gases. Greater drafts than necessary serve to increase losses due to air leakage through furnace settings, walls, and openings.

3. Reclamation of heat. The use of flue gas heat recovery equipment is of significant importance with increasing operating temperatures. In such industrial furnace operations as the burning of Portland cement and firebrick where the material or stock is heated to approximately 2700 F, reclamation of flue gas heat is extremely economical. For the range of stack temperatures shown in the graphs, air heaters and economizers are used extensively for flue gas heat recovery.

Using the sensible heat of flue gases to preheat combustion air increases the flame temperature and this in turn increases the rate of heat transfer from the hot gases to the operating media. The over-all effect of air preheating is to increase the operating efficiency. Its use, however, is most satisfactory with furnaces and boilers having continuous and non-fluctuating loads. Installing economizers to heat makeup feedwater with the sensible heat of stack gases is satisfactory where the makeup water demand is continuous and uniform.

4. Industrial oxygen. Application of industrial oxygen is gradually finding its place in many combustion operations. However, to date its use has been primarily to obtain the high flame temperatures required in many industrial process operations.

High humidity and rapid drop in ambient temperature may cause excessive condensation and moisture accumulation. Either a direct or a strip heating circuit can rout the moisture.

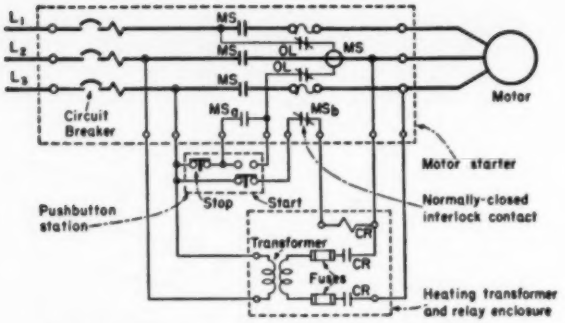


Fig. 1—Method of controlling heating transformer output to motor windings using a combination starter.

Preventing Moisture Absorption by

Heating Motor Windings

FRANK E. REEVES
Consulting Engineer

HIGH HUMIDITY in some industrial plants and in outdoor atmospheres in some parts of the country frequently make it necessary to apply heat to the inside of a motor housing to prevent moisture absorption and consequent lowering of insulation resistance in the windings. Such moisture absorption also may occur where relatively sudden temperature changes cause rapid condensation and moisture accumulation within the motor housings. Special treatment of windings for high humidity is very important in preventing breakdown of insulation under such conditions. When the application environment is severe, some form of heating may be necessary during shut-down periods.

Totally enclosed motors are not immune to these problems. They are not hermetically sealed, and some breathing always takes place. If the surrounding atmosphere is fairly well saturated, a considerable amount of moisture will enter the housing. In some instances, water has been removed from totally enclosed motors by the cupful.

In large motors, particularly in the high-voltage types rated over 550 volts, there is enough room for strip heaters; these are in common use. In smaller motors, rated 440 volts and below, there is not adequate space within the motor for such strip heaters, and another expedient must be employed. A small single-phase transformer may be connected to the motor feeder ahead of the motor starter or controller, with its secondary terminals connected to one phase of the motor's stator winding. A switching device is necessary to permit breaking the connections when the motor is in use.

A scheme for connecting and disconnecting the source of heat from a motor is shown (Fig. 1). The magnetic motor starter is equipped with an auxiliary normally-closed interlock contact (MS_b). This contact is closed when the contactor in the motor starter is in the open position, and is open when the contactor is closed and the motor is running. The coil of a control relay (CR) is connected in series with this contact so that it is energized when the contactor is open. This relay has two contacts, one in each leg of the secondary circuit of the small heating transformer. When the motor is not in use, these contacts are closed and the secondary of the heating transformer is connected directly across one phase of the motor stator. If the transformer has the proper characteristics, the current in the motor winding will be sufficient to maintain the temperature of the air within the motor enclosure at 5 to 10 C above ambient. If the ambient temperature should change suddenly, this temperature differential is usually adequate to prevent the entrance of moisture or to prevent the condensation of moisture within the motor. When conditions are particularly severe, a transformer having a higher rating, with a higher secondary voltage, may be used to maintain temperatures from 15 to 20 C above ambient in the motor during its down period.

In this arrangement, when the motor "start" pushbutton is actuated, the coil of the relay is first de-energized by the opening of the normally-closed pushbutton contacts. The control relay contacts open before the normally-open contacts of the motor starter contactor can close. In the event the contacts of the control relay stick closed after the motor "stop" pushbutton is pressed, the fuses in the secondary circuit of the heating transformer will blow, preventing damage.

When several motors of approximately the same ratings are involved, a single heating transformer may be used to feed all such motors during their shutdown periods. The arrangement shown (Fig. 2) is one in which manually operated air circuit breakers are used as motor controllers instead of the usual contactor type motor starters. Overload protection for the

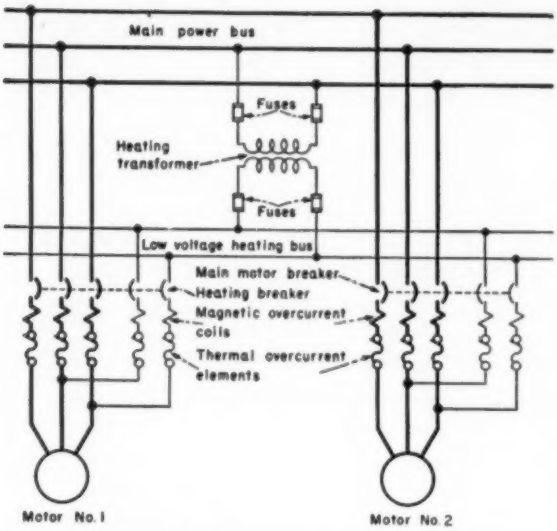


Fig. 2—A single heating transformer may be used for several similarly though not equally, rated motors.

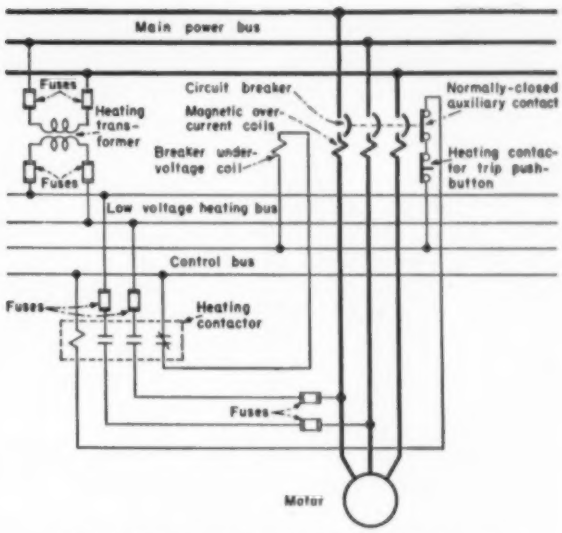


Fig. 3—When mechanical interlocking is not practical, electrical interlocking may be used instead.

motors is provided by thermal elements which trip the circuit breakers in the event of prolonged overload which might damage the windings of the motors. The standard magnetic overcurrent elements of the air circuit breakers provide short circuit protection. A 2-pole air circuit breaker is used for interrupting the heating current. The 3-pole and the 2-pole breakers are mechanically interlocked to prevent simultaneous closure.

When breakers used for motor controllers are electrically operated, the heating control is somewhat more involved (Fig. 3). In such cases, a 3-pole heating contactor is used. The contactor has two normally-open and one normally-closed contact. The two normally-open contacts control the feed to the motor windings, and the normally-closed pole is used for interlocking. The breaker used as the motor controller is equipped with an undervoltage release which not only trips the breaker when its coil is de-energized but also locks the breaker in the open position. This prevents a race between the opening of the contacts of the heating contactor and operation of the main circuit breaker contacts when the breaker is to be reclosed. Before the circuit breaker may be closed, the undervoltage coil must first be energized. Since it is fed through the normally-closed contact on the heating contactor, this contactor must be in the open position before the undervoltage coil may be energized. This is accomplished by actuating the heating contactor trip pushbutton before turning the circuit breaker control switch to the "close" position. The proper contact sequence is thus assured to prevent blowing fuses.

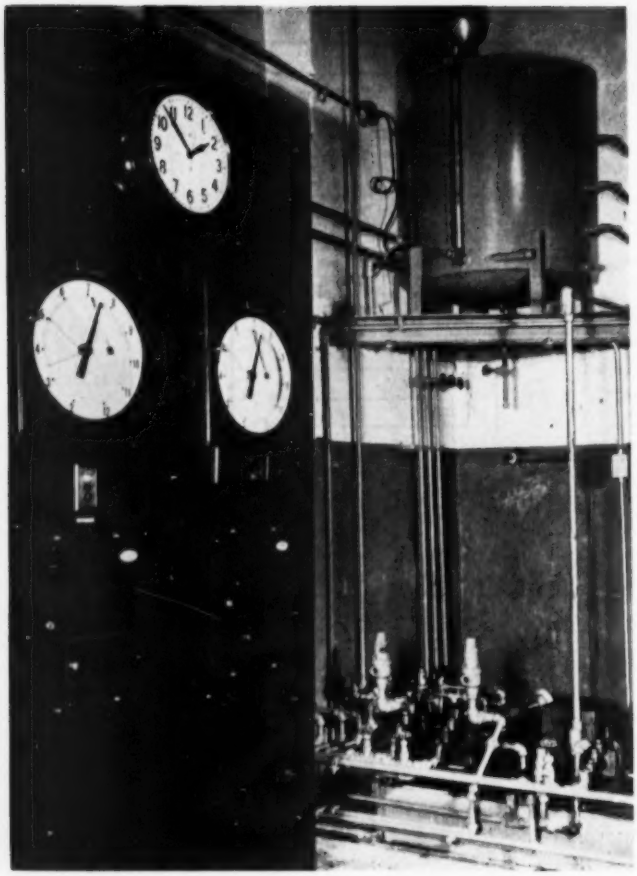
When the motor is shut down by tripping the circuit breaker, the normally-closed auxiliary contacts on the breaker close, causing the coil of the heating contactor to be energized, feeding low voltage power to the motor windings for heating purposes. The breaker's undervoltage coil becomes de-energized, but since the breaker is already open, it simply performs its lockout function.

Although the first cost of the control equipment for the direct heating method described is somewhat higher than for strip heaters, considerably less power is required to maintain the same temperature. If this power is capitalized, it would more than offset the additional cost of control equipment required for low-voltage motors. For high-voltage motors, strip heaters are undoubtedly more economical because of the much higher cost of the transformer and control equipment required for direct heating.

The table gives required power and volt-amperes necessary for direct heating of totally-enclosed motors for various sizes and speeds. Using values from the table, proper sizes of heating transformers may be determined. For other types of motors, the manufacturer should be consulted regarding heating power requirements.

HEATING REQUIREMENTS FOR TOTALLY ENCLOSED 3-PHASE, 60-CYCLE, SQUIRREL-CAGE INDUCTION MOTORS TO GIVE 5 TO 10 C RISE ABOVE AMBIENT TEMPERATURE

Nominal synchronous speed and horsepower of motor						*Heating requirements*	
600 rpm	*720 rpm*	*900 rpm*	*1200 rpm*	*1800 rpm*	*3600 rpm*	*watts*	*volt-amps*
—	—	½ hp	¾ hp	1 hp	1½ hp	30	80
¼-½ hp	⅓-½ hp	¾	1-2	1½-3	2-5	35	90
¾-1	¾-1½	1-2	3	5	7½	45	125
1½	2	3	5	7½	10	60	175
2-3	3-5	5-7½	7½-10	10-15	20	90	250
5	7½	10	15	20-25	25	110	330
7½-10	10-15	15-20	20-25	30	30-40	130	390
15-20	20-25	25-30	30-40	40-50	50	175	525
25-30	30-40	40-50	50-60	60-75	60-75	200	600



The James Lees & Sons mill uses the muddy Schuylkill for process water. Faced with treating a half-million gallons per day, with turbidities from 10 to 950 ppm and wide pH ranges, they designed a system based on proportioning pumps and automatic control instruments.

Part of the indicating and recording controls. Silica pot and Milton Roy proportioning pumps at right.

Dirty Water Gets The Treatment

JOSEPH TYLER
Superintendent, Power and Maintenance
James Lees & Sons Company

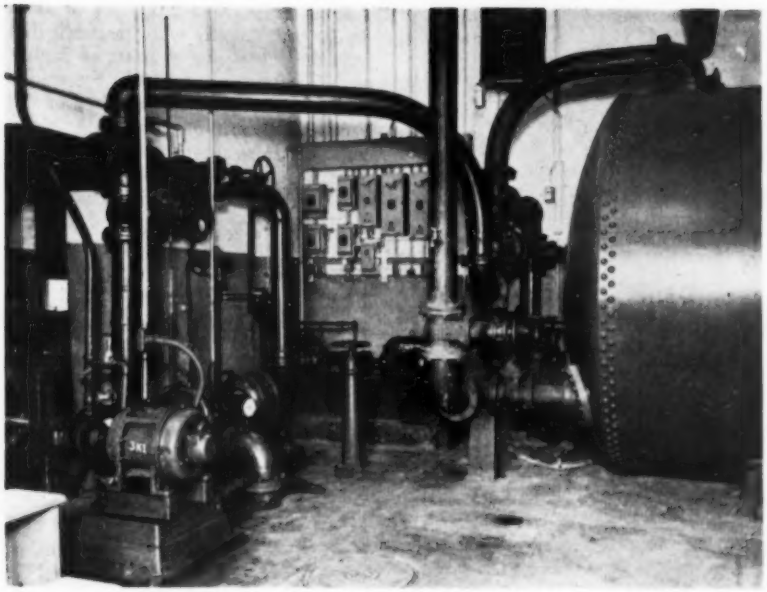
JAMES LEES and his sons built during the Civil War the worsted yarn mill which still stands on the banks of the Schuylkill River at Bridgeport, Pa. With the growth of industry and towns in this area, the quality of the river water decreased deplorably as the stream became the receptacle for all industrial wastes, including tons of fine coal discarded by the anthracite producers in their coal washing operations in northeastern Pennsylvania. The condition became so acute that the Schuylkill was popularly described as being "too thin to plow, too thick to drink by the local population.

The problem of treating enough water efficiently and satisfactorily for all of the expanded and diversified activities of Lees & Sons has in recent years become a major task for the plant engineers. Although Pennsylvania's clean streams program has eliminated much of the coal silt from the river, suspended organic solids from sanitary sewage and high turbidities from land erosion during periods of run-off deteriorate the quality of the water. Consequently, it was mandatory that the river water be treated if the company was to produce top quality carpets. Instrumentation provided the solution to the problem of treatment.

Nature of Problem

The Bridgeport mill consumes a million gallons of Schuylkill river water each day, half of which must be treated before it can be used as process water. The turbidity of the raw river water varies from 10 ppm to 950 ppm and changes in the matter of a few hours. It is not uncommon for the turbidity to increase overnight from 12 ppm to 650 ppm. Process water, for best results in the mill, cannot have a turbidity greater than 8 ppm and must have a pH of 8 at all times.

Formerly, treatment consisted of the manual dumping of alum into the raw water which flowed through a mixing trough and a series of settling tanks with under and overflow baffles. The



Settling tank and pumps shown at left are all automatically controlled.

settled effluent was pumped through sand filters and sodium zeolite softening beds, and then pumped to storage tanks. Since the process water had to have a pH of 8, the alum had to be added in limited amounts and advantage could not be taken of the optimum pH range (6.5-7.0) for best flocculation of alum solution.

When the river was "running red" or was highly turbid, the treatment usually was tedious and inadequate. Frequently the turbid water resulted in difficult filter plant operation. The water was not sufficiently clarified and the sand filter beds became plugged and had to be back-washed at rates which consumed large quantities of previously treated water, reducing the capacity of the filter plant from 550 gpm to 100 gpm. Sometimes alum was added in excessive amounts, by alarmed personnel who had the mistaken belief that a more liberal use of alum would give them less turbid water for dyeing. As a result, pin point alum floc was carried over into the storage tanks.

Controlled Feeding

Advice was sought on how to treat the water satisfactorily and adequately when the river was "running red." Three of the four consultants retained advised the use of Milton Roy pumps to proportionately feed activated silica for better flocculation with a minimum amount of alum, and to feed caustic for adjustment of the pH of the clarified and softened water. The resulting water treatment system is shown schematically in Fig. 1.

River water is pumped to a baffled trough where the activated silica and alum are added at the influent end. Seven parts per million of activated silica are added to the raw water in proportion to the flow. This is accomplished by means of a flow meter on the influent line with electrical contacts. The meter measures the flow and simultaneously actuates three air-operated Milton Roy controlled volume pumps with micro stroke length adjustment for capacity regulation. One pump feeds sodium silicate solution to the mixing and aging tank, one feeds clarified water, and the third feeds sodium bicarbonate, the activating agent. The pumps have been designed to feed the three components of the activated silica in proper relative proportions of each.

The solution in the mixing and aging tank is mechanically agitated and the activated silica overflows to the influent end of the baffled trough. In order to control the aging time of the silica, the tank is tapped at three elevations. Aging time depends on the elevation from which the activated silica is allowed to overflow—the lower the elevation the less the capacity or retention time of the tank.

Alum Feed Rate

The alum feed is automatic, with the feed rate manually adjusted in accordance with the resulting pH, which is measured and recorded by means of a Beckman flow-type pH cell and amplifier assembly and a circular chart electronic pH recorder and indicator developed by Minneapolis-Honeywell. The results of any incorrect valve settings on the alum feed line are recorded by the potentiometer and adjustments can be made before any damage results to the system.

After flowing through the baffled trough, the raw water containing the activated silica and alum drops into a series of underground settling tanks interconnected in series by under or overflow baffles. From the final tank, called the clear well, the water is pumped through two horizontal sand filters operated in parallel. A small auxiliary pump at the clear well pumps a portion of the clarified water through the pH cell. An emf signal in proportion to the pH is transmitted to the panelboard potentiometer. The panelboard is centrally located with respect to all of the water treatment facilities.

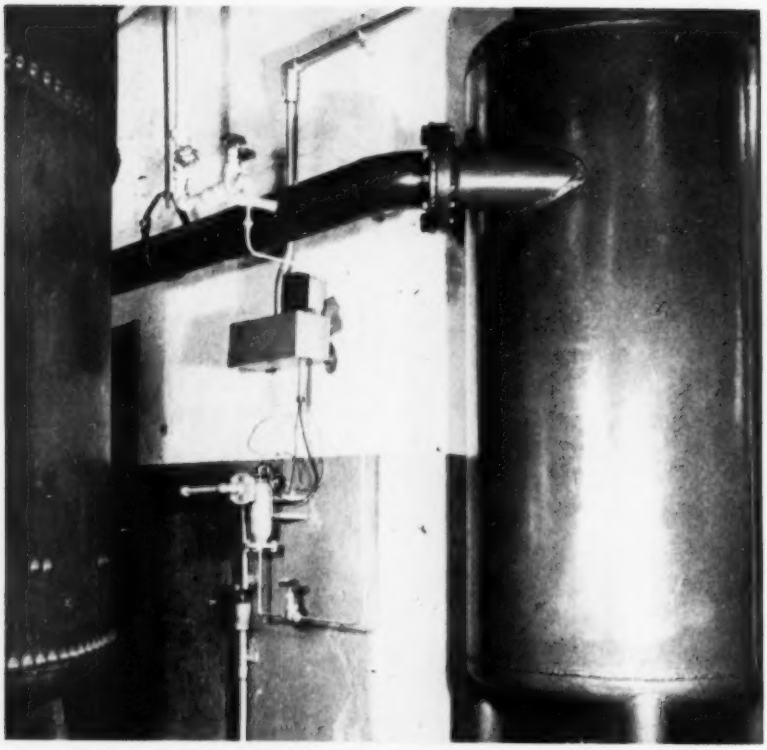
Controlled pH Adjustment

After being filtered, the clarified water is softened by the sodium zeolite method in three vertical tanks operated in parallel. The underflows from the three tanks of clarified and softened water are mixed in a baffled tank and pumped to storage tanks. Immediately after the water is mixed, a continuously flowing sample is by-passed through a second Beckman flow-type pH electrode assembly which transmits an emf in proportion to the pH to a second circular chart pH recorder and indicator. The latter instrument features Electr-O-Line relay with proportional-plus-reset control and operates a small motor which regulates the stroke length —therefore capacity—of a Milton Roy motorized micro controlled volume pump. The pump feeds caustic to the clarified and softened water. The caustic is introduced in the line between the softening tanks and the baffled mixing tanks by the pump.

A red alarm signal on the panelboard attracts the operator's attention to an unsatisfactory pH of the clarified water in the clear well.

Features of the System

The system has cut the use of alum while at the same time assuring the dyehouse plenty of good water. The most severe river water conditions create no clarifying or operating problems in the filter plant since the new chemical feed system has been in service. Under the old system on some oc-



The Beckman flow type pH electrode is installed below the main to the storage tanks. The baffled mixing tank is shown at extreme right.

casions as much as 2,000 lbs of alum in 10 to 12 hours were manually fed into the raw water at times of highly turbid water and even then the results were unsatisfactory and the bed of the sand filters became plugged. Now, with the new automatically controlled system and continuous pH records, 200 lbs per day is the largest amount of alum used, even during periods of high run-off when the Schuylkill is red and muddy, with turbidities as high as 950 ppm at peak periods.

Besides reducing the cost for chemicals, eliminating the need for operators working double shifts and producing a continuous, adequate supply of good water, the new controlled chemical feeding system solves the problem of how to treat the water at pH 6.5 for optimum flocculation while maintaining continuous supply water at pH 8.0 to the plant.

As modernization and expansion programs continue to be initiated at Bridgeport, greater volumes of water will be required. The new controlled system affords the maximum use of the existing facilities beyond designed capacities without sacrificing quality. Supervisory personnel are released from operating problems and can take time to design and establish a program for improved quality of product.

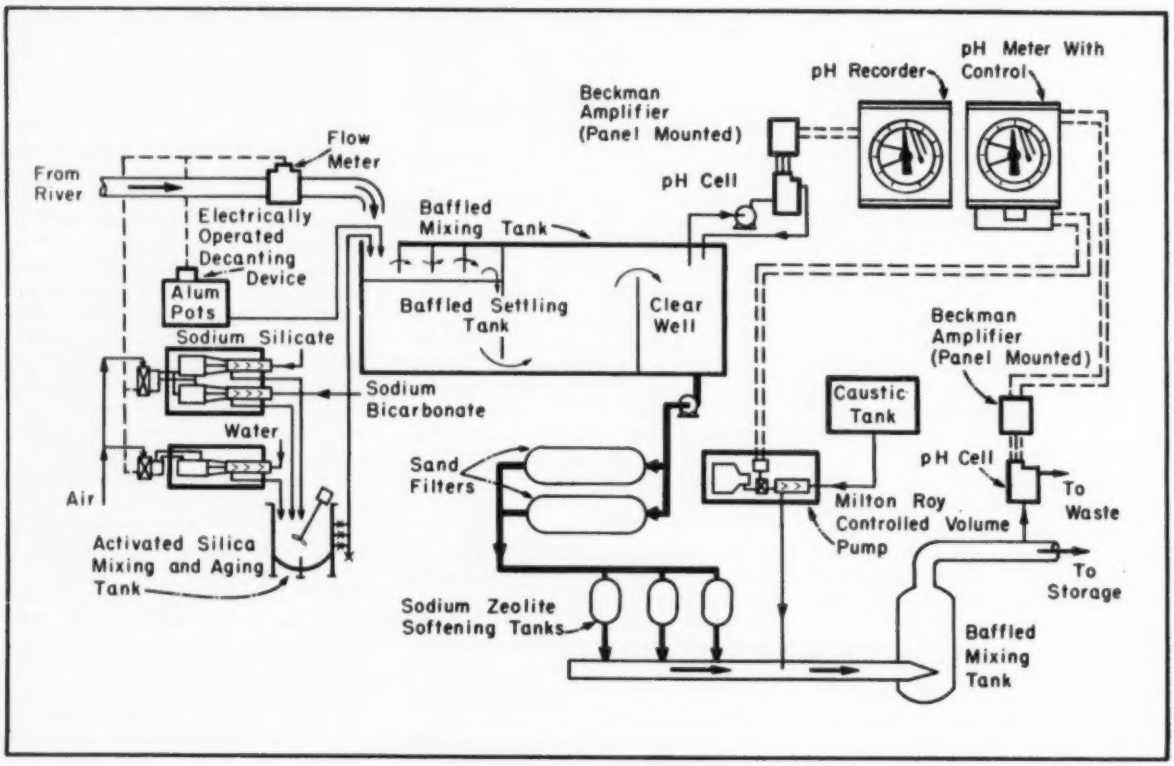
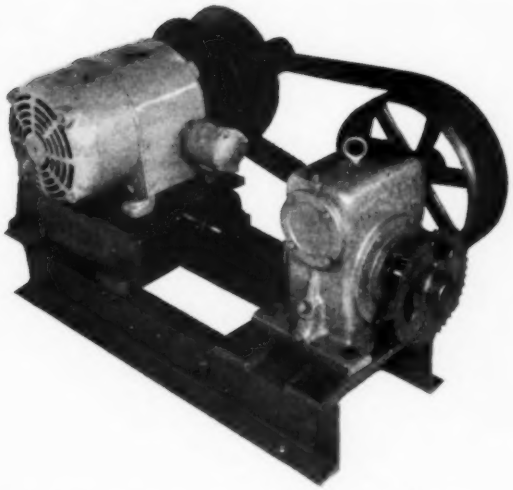
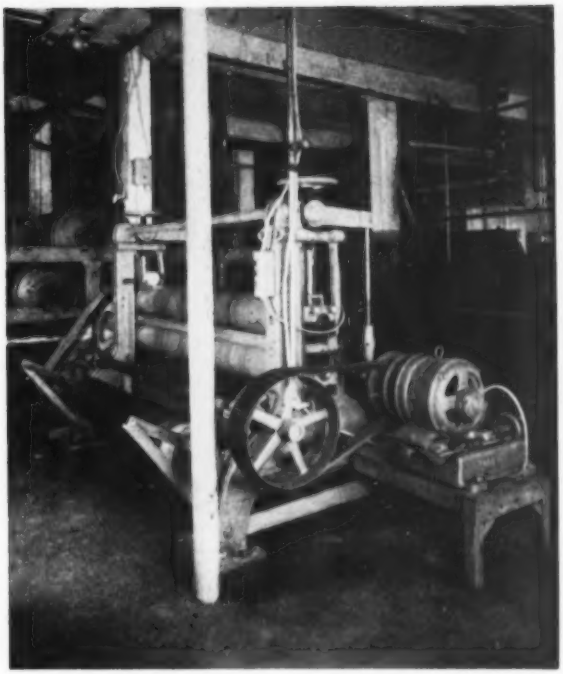


Fig. 1—Schematic of the water treatment system showing pumps, mixing and settling tanks, and instrumentation.



Variable pitch motor pulley assembly. Compact units can be made by mounting the driven sheave on a gear reducer.



A water mangle, which must operate at different speeds, uses the drive from a variable pitch motor pulley installation.

Variable Pitch Motor Pulleys for Power Transmission

RICHARD LeBARON BOWEN, JR., ***Vice-President***

Coated Textile Mills, Inc.

Pawtucket, R. I.

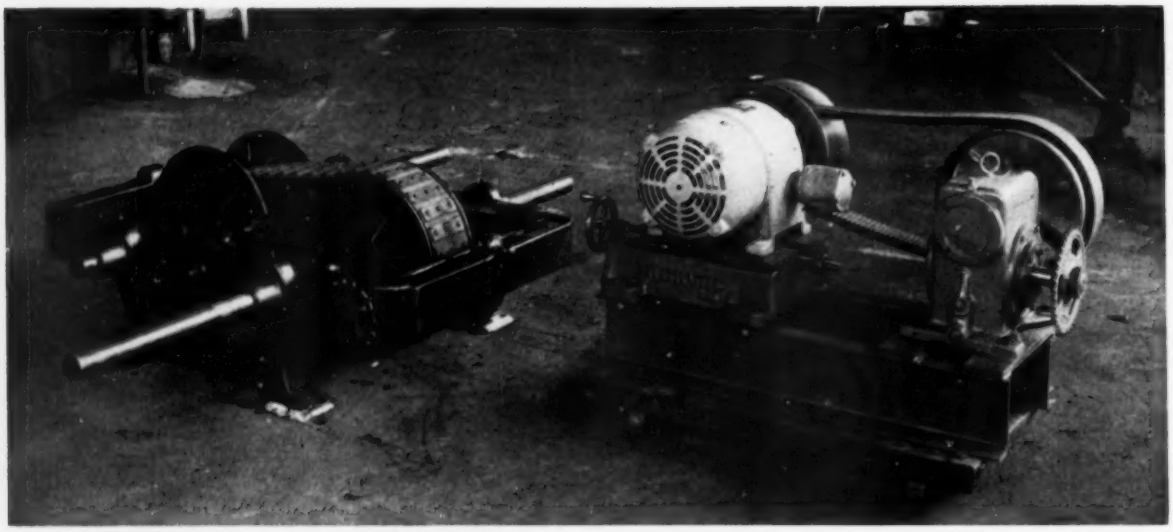
A MODERN DEVELOPMENT of mechanical power transmission has been an increase in speeds and a reduction in size of the equipment. Such a trend is well illustrated by variable pitch motor-pulleys which are mounted directly on the motor, speed being varied by moving the motor in a direction perpendicular to the axis of the motor shaft.

These motor-pulleys produce speed variations when, by turning a handwheel, the motor moves forward or backward on its specially built base. As the motor is moved forward, the belt tension is decreased, the two disks are forced together by a spring arrangement, the belt rides on a larger arc of contact or pitch diameter, and thus increases the speed. Conversely, as the motor is moved away, the belt forces the two disks apart, decreasing the pitch diameter and the speed.

There are two important types of variable pitch motor-pulleys. The first type uses one disk firmly keyed to the motor shaft and one sliding disk which is keyed to a collar extended from the stationary disk. There is only one moving part in this model (disregarding the spring). A characteristic of this type of pulley is that as the transmitted speed is reduced, the centerline of the belt is shifted away from the motor. Therefore, the belt must run on a flat-faced pulley. If maximum horsepower is to be developed, a wider belt must be used for the flat faced pulley than for a similar drive using a wide V sheave. There is a German model which omits the key between the stationary disk and the sliding disk thus eliminating a source of maintenance when wear becomes excessive.

In the second type, two sliding conical disks are mounted on a sleeve which, in turn, is mounted on the motor shaft. There are several designs of this motor-pulley. One, manufactured by the Gerbing Manufacturing Corporation, and known as the Roto-Cone, uses a single spring (Fig. 1) similar to the stationary disk type. The two disks are kept equi-distant from a fixed centerline by a pinion common to racks fastened to both disks. In this design there are three moving parts. All parts, however, are precision machined to required tolerances.

Another design is that manufactured by the Lovejoy Flexible Coupling Company. Here, two sliding disks are moved together by two calibrated



Old double sheave variable speed transmission and the unit which replaced it. Note the compactness of the new unit.

springs which keep each disk equi-distant from a fixed centerline (Fig. 2). The faces of these pulleys are curved to give full belt contact at all speeds. There are two moving parts incorporated in this design.

In both of these designs, a wide V-belt drives a wide V-belt sheave. This makes for high operating efficiency while at the same time making use of a smaller V-belt than would be necessary with a flat faced pulley. Usually, the next smaller belt size can be used with a wide V-belt sheave.

Past Practice

Before the advent of the variable pitch motor-pulley, variable speed mechanical power transmissions often consisted only of two sets of conical disks on two shafts. Another variation had two cones facing in different directions, with either a belt between or a belt around the cones. One of the commonest of these large two-shaft transmissions today is designed with double adjustable sheaves. There are eight bearings on these; four on the frame to hold the shafts and four thrust bearings acting to hold the disks against the belt. Most of these use a composite rubber belt with wooden blocks on the belt to give added contact. Link-Belt uses a specially designed metal belt (PIV Gear), while Allis-Chalmers has developed a design of this type using conventional V-belts.

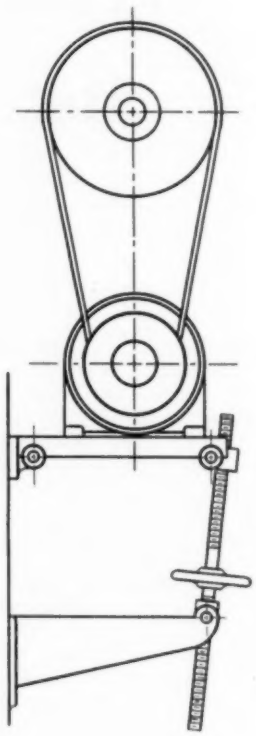
All of these transmissions have one operating characteristic in common: the maximum speed of the constant speed input shaft is relatively slow. In the composite belt types, the maximum recommended speeds vary from about 200 to 700 rpm (the slower speeds with the higher hp units). With the metal belt, the maximum recommended input speeds vary from 500 to 860 rpm, and with the Allis-Chalmers model input speeds of from 800 to 1500 rpm are possible. All require speed reducers on the motor shaft (with the exception of several Allis-Chalmers models where a 1200 rpm motor can be directly coupled to the shaft.)

Advantages

With a variable pitch motor-pulley, the eight bearings of the variable-speed transmission are eliminated since the motor-pulley's bearings are on the motor. The motor-pulley is inherently more efficient because no horsepower is lost driving the transmission. If the required maximum driven speed is between 500 and 1500 rpm, the driven sheave may be mounted directly on the machine shaft, using an 1800 rpm motor for the high speeds, and a 1200 rpm motor for the low speed range. A large speed reduction is not practical in going from the variable pitch motor-pulley to the driven sheave. The motor pulley is normally large in diameter and thus any reduction over two to one would require an unnecessarily large sheave diameter.

If low speed is required with the variable pitch motor-pulley, very compact units can be made by mounting the driven sheave on a right angle worm gear reducer or a parallel shaft spur gear reducer. Speed reductions ranging up to several hundred to one can be obtained with either type.

It may be claimed that some of the so-called "motor-drives" (motorized variable-speed transmissions) are as economical in initial cost as a variable pitch motor-pulley driving a sheave mounted on a gear reducer. These motor-drives have an adjustable pitch pulley mounted on the motor shaft,



Arrangement of a vertical pivoting motor base with a hand adjustment.

which drives a second variable pitch pulley mounted on a second shaft, with which may be a gear reducer if necessary. However, the variable pitch motor-pulley and gear reducer assembly is usually cheaper than the motor-drive and has fewer moving parts (two less sliding disks) and bearings. Even when a motor-drive is the same price, the variable pitch motor-pulley may be more desirable because of maintenance economies and because of its simplicity. The motor-drive is sometimes used because it is totally enclosed and can be purchased with the proper variable speed range and the desired output speed. However, the variable pitch motor-pulley may be built into any machine to produce a more compact and integral unit.

Cost Comparisons

The major cost comparisons between variable pitch motor-pulleys and other variable-speed transmissions indicate that the motor-pulley runs about one-sixth the cost of the cheapest double adjustable sheave transmission. The cost of transmissions with metal belts is 10 to 15 times the cost of motor-pulleys. Therefore, it can be concluded that the variable pitch motor-pulley is the cheapest variable-speed power transmission made.

Why is this variable pitch motor-pulley not used more often? The main limitation is the fact that the variation in speed is limited to 3:1 although some of the smaller units do have a 4:1 range. Another limitation is that the rating of the units is limited to 15 hp. Here again, this is not a limitation for the majority of applications.

The main reason for infrequent use of the variable pitch motor-pulley seems to be a lack of familiarity on the part of plant engineers, and a preference of machine design engineers for totally enclosed units, even though they may cost considerably more. In the latter case, the additional cost is simply added to the machine cost, which is usually many times the cost of the transmission. There are also doubts that such a simple unit as the variable pitch motor-pulley can do the job of units that cost from 6 to 15 times more.

The variable pitch motor-pulley has found widespread application on all types of machinery installations. It has been used on machine tools, textile machinery, chemical equipment, printing presses and many others. At the Coated Textile Mills, Inc., all existing double adjustable sheave transmissions are being replaced by variable pitch motor-pulley units with the exception of a few cases where speed variations of over 3:1 are required. On any new machinery, the variable pitch motor-pulley is specified if the range of speed variation is not over 3:1. The unit makes a neat installation.

Storage Batteries Unharmed By Fluorine-Treated Water

RECENT EXPERIMENTS on battery life have revealed that fluorine, as added to municipal water supplies to help prevent tooth decay, has no harmful effects when used in the electrolyte of industrial batteries.

The tests were conducted at the Gould-National Batteries laboratory at Depew, N.Y. The company sought to determine whether supplies of undistilled city water containing fluorine were harmful when used to replace water evaporated from industrial batteries.

Drinking water treated with fluorine normally contains two parts of fluorine per million parts of water. As water evaporates and is replaced, fluorine accumulates in the battery and may reach a concentration as high as 30 parts per million under the most unfavorable circumstances. To stimulate the accumulation of fluorine, the laboratory added 86 milligrams of sodium fluoride to one cell in each of three industrial batteries. It then put the batteries on a life test that took them through their life span in a shorter time than under actual operating conditions.

The cell containing fluorine and two adjacent untreated cells in each battery were observed throughout the test until the batteries failed. The cell showed no unusual behavior and did not fail before one of the other two cells.

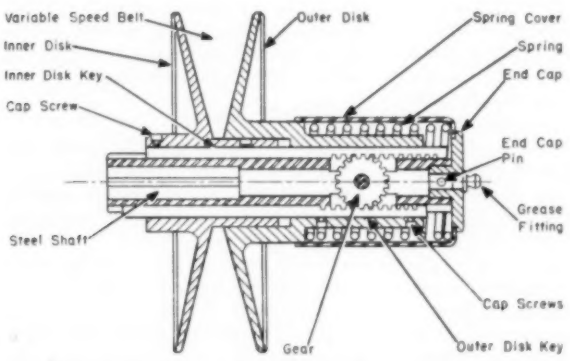


Fig. 1—Cross-section of pulley with two sliding disks. A pinion common to two racks keeps the disks at fixed distance.

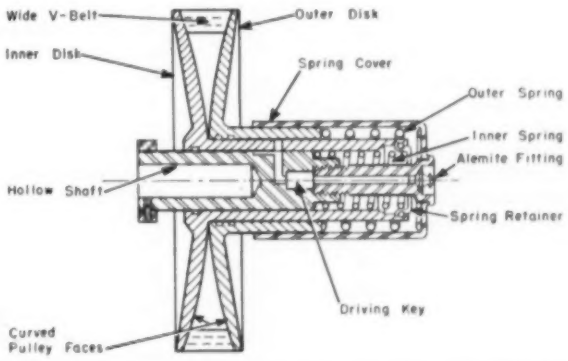


Fig. 2—This pulley arrangement uses two carefully calibrated springs to keep disks equidistant from a fixed center line.

The use of two-way radio communication in the operation of integrated steel mill facilities permits higher utilization of capital equipment and labor, through instant contact with distantly located operators.

Distant dispatchers route mill trains by issuing orders to the train operating crews over mobile equipment.

Two Way Radio

Steel Mill Communications

W. M. MARTIN
Illinois Bell Telephone Company

TWO-WAY MOBILE RADIO communications systems are engineered and installed in a wide variety of arrangements. The applications in the steel industry have helped increase production, lower cost, and provide safer working conditions.

As in most other applications, the basic system consists of a radio base station with several mobile units and perhaps several hand-carried stations. The system can be arranged to permit mobile-to-mobile communication without going through the base station. With such instant communication between personnel, costly delays in stock handling and material movements are considerably reduced.

The Federal Communications Commission allocates and regulates the use of the radio spectrum in the public interest. The Commission has designated service categories and assigned specific frequencies to each category. Two-way mobile radio systems for the steel and other industries come under the Special and Low-Power Industrial Services classification. The Special Industrial Service group covers a greater range than the Low-Power Industrial Service; the Low-Power band is usually limited to portable "handtalkie" units.

Both of the industrial categories operate in frequency bands of 27-50, 152-155, and 455-458 mc. Each of these frequency bands exhibits distinct operating characteristics, with the lower frequencies providing somewhat greater range than the higher.

This advantage may be offset by other considerations. Receiving equipments operating on the 27-50 mc band are more susceptible to ambient man-made noise. Such noise tends to degrade the quality of communications in areas of high electrical noise levels. Under certain atmospheric conditions, "skip transmission" is more likely to occur on the lower frequencies. When these conditions prevail, stations hundreds of miles distant and operating on the same frequency literally skip those huge distances and may be received at signal levels sufficiently strong to interfere with local communications.

Antenna Lengths

From the equipment standpoint, antenna lengths may favor the higher frequencies. The approximate antenna lengths characteristic of the industrial service bands are:

27-50 mc	72 in.
152-155	18
455-458	5

The 455-458 mc frequencies have not been used extensively because the radio equipments for these frequencies have just recently become avail-

Aimless cruising is eliminated when plant vehicles are in constant touch for immediate instructions.

All classes of equipment which move from one work site to another are easily supervised by radio.

able in commercial quantities. There is every indication that this band will be used quite widely for new industrial systems, both for initial systems and to relieve traffic overloads on existing systems.

Interplant Facilities

There has been a definite tendency in the past several years to operate two-way radio systems for interplant communications on the 152-155 mc frequencies. These frequencies are assigned on a shared basis, as is true for all industrial frequencies. This has created some crowding of the band. The crowding effects can be minimized by engineering the systems for maximum compatibility and minimum interference. This can be done by limiting the radiation of each sending unit so that the covered area does not needlessly extend to interfere with distant stations.

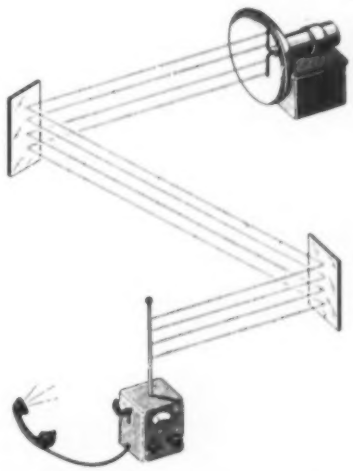
The heavy use of two-way radio as an extremely important production tool has caused the communication industry to develop improved equipments and methods of operation to solve the crowding problem. Since there are, at the moment, no additional frequencies available for assignment and there continues to be a heavy demand for industrial radio frequencies, one answer to the load problem is fuller usage of the existing frequency bands. Several types of equipment are now available which will provide satisfactory service while occupying only one-half the frequency bandwidth previously required.

Specific application of radio equipment is typified by the installation of a mobile station in the cab of a steel mill railroad switch engine. The chief dispatcher can instantly inquire about the contents of each string of cars. If a particular string has a load required at a specific location, the engine can be directed to haul the load to the designated point immediately. Other mobile equipment, such as power shovels, are similarly assigned work sites. The entire tempo of operations is speeded up.

Future Developments

There is every indication that microwave will play an ever-increasing part in the communication picture. Microwave is generally considered as that radio range above 900 mc. The frequency spectrum above this point is long enough to permit relatively large bandwidths. This eliminates crowding and accommodates systems of large capacities. There is a further advantage to microwave—the propagated energy from the transmitter can be focused and reflected much as light rays, permitting a high degree of privacy. Such advantages apply well to an integrated interplant two-wave radio communications system, permitting unit operation of several plants physically separated.

At the present time, FCC rules permit certain groups within the industrial category—power utilities, railroads, and the petroleum industry—to qualify for microwave frequencies. The regular industrial user in the manufacturing classifications does not qualify for microwave facilities if the required service can be provided by conventional wire means.



This sketch illustrates the reflective and directive nature of microwave communication channels.

Centrifugal Pumps . . .

Bearings

Fig. 1—Double row, deep groove ball bearings are in effect two single row bearings side by side. They handle radial-thrust loads.

While ball bearings have replaced sleeve bearings on most centrifugal pumps, sleeve types are still used for small, inexpensive pumps and for very large, heavy-duty pumps with large diameter shafts.

IGOR J. KARASSIK & ROY CARTER
Worthington Corporation

FUNCTION OF BEARINGS in centrifugal pumps is to support the shaft or rotor in correct alignment in relation to the stationary parts under the action of radial and transverse loads. Bearings, which give radial positioning to the rotor, are designated as line bearings, and those that locate the rotor axially are called thrust bearings. Bearings serving both purposes are properly called combined radial and thrust bearings but usually are called simply thrust bearings.

For the double-suction, single-stage, general service pump, two external bearings, one on either side of the casing, are generally employed. Most manufacturers have changed to antifriction bearings utilizing either grease or oil lubrication. Some of the small, inexpensive centrifugal pumps for pumping clear liquids, are provided with an internal sleeve bearing, as shown in Fig. 1.

Pump bearings may be of the rigid or of the self-aligning type. A self-aligning bearing will automatically adjust itself to a change in angular position of the shaft. Self-aligning sleeve type bearings have a spherical fit of the sleeve in the housing. In antifriction bearings the outer race is spherically ground or the housing provides a spherical fit for the bearing.

Ball bearings are frequently used in centrifugal pumps while roller bearings are used to a lesser extent, being suited only to radial loads. Spherical roller bearings are used for large shaft sizes. Although double-suction pumps are theoretically in hydraulic balance, this condition is rarely realized in practice, and even these pumps are provided with thrust bearings, usually of the combined radial and thrust type.

As centrifugal pumps are a product of the foundry, minor casting irregularities usually exist. These irregularities may cause eddy currents to be set up on the two sides of the impeller, resulting in an axial hydraulic thrust. In addition, unequal wear of the rings and other parts may cause unbalance. Finally, the flow of the liquid into the two suction eyes may be unequal because of an improper suction piping arrangement. As a result, some form of thrust bearing, capable of taking thrust in either direction, is necessary even for double suction pumps in order to maintain the rotor in its proper axial position. Generally, the thrust capacity of such a bearing is far in excess of the probable unbalance due to irregularities.

Ball Bearings

Theoretically, ball bearings operated at an absolutely constant speed would require no lubricant. However, no speed can be called absolutely constant as the conditions affecting the speed will vary slightly. For example, a motor whose full load speed is given at 3510 rpm might vary in speed in the course of a minute from 3505 to 3515 rpm. Each variation in speed has the effect of causing the balls in a ball bearing to lag or lead the race because of their inertia. This means that there is a very slight sliding action taking place. Also, the hardest of metals suffer minute deformations on carrying load, and point contact does not always exist. This also causes a slight sliding action. For these reasons ball bearings must be given some lubrication.

Ball thrust bearings are built to carry heavy loads by pure rolling motion on an angular contact. Since thrust load is axial, it is equally distributed to all the balls around the race, and the individual load on each ball is only a very small fraction of the total thrust load. In bearings of this type it is essential that the balls be equally spaced. A retaining cage must separate the balls between the inner and outer race.

Types and Applications

Most common ball bearings for centrifugal pumps are the single-row deep-groove, the double-row self-aligning, and the angular-contact types made both in the single or double-row. All except the double-row self-aligning type are capable of carrying thrust loads as well as radial loads. The ball thrust bearing was formerly used for carrying thrust only in conjunction with babbitt sleeve bearings, but it is now rarely used on centrifugal pumps. Sealed type ball bearings, adapter type ball bearings, and other modifications also have some application. Pre-lubricated bearings require special attention

Fig. 2—Double row angular contact type carries thrust either way.

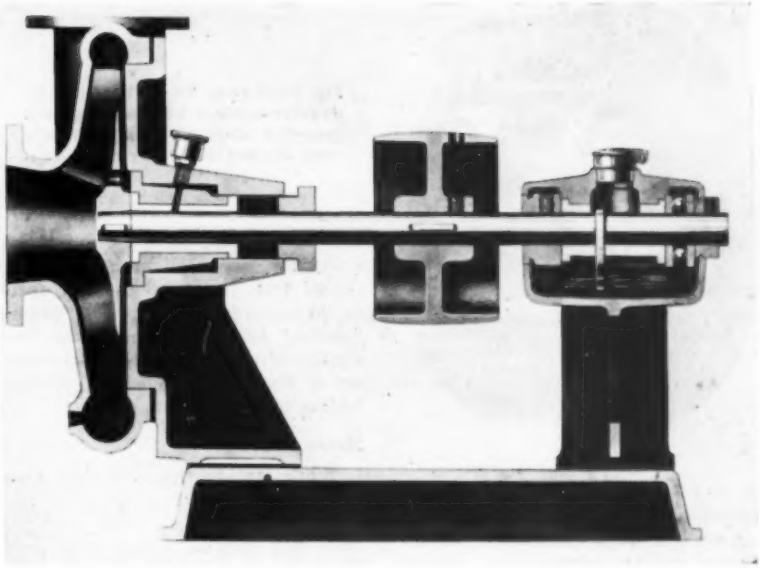


Fig. 3—Internal sleeve bearings.

if the unit in which they are installed is not operated for a long period of time. In such cases, the shaft should be turned over occasionally, say once every three or six months, to agitate the lubricant and maintain a film coating on the metal surfaces.

The self-aligning type of ball bearing is the most serviceable type for heavy loads, high speeds, long bearing spans, and no end thrust and is ideally adapted to service as a line bearing on a centrifugal pump. The double row of balls run in fixed grooves in the inner race, and the outer race is ground to a spherical seat. Any slight vibration or shaft deflection is taken care of by this self-aligning bearing which operates as a pivot. In cases of lightly constructed pumps, "breathing" may take place in the casing when pressure is developed. This self-aligning bearing is desirable, as the slight misalignment caused by "breathing" will be compensated for in the bearing.

With large shafts, the self-aligning spherical-roller type is employed instead of the self-aligning ball bearing. The self-aligning spherical roller, unlike the ball bearing type, can carry a load with a considerable thrust component.

Single-row deep-groove ball bearings are the most favored by the bearing manufacturers as they are applicable to so many services and permit standardized production methods. This bearing is capable of carrying both radial and axial loads and, for conservative speeds, low end thrusts, and short spans, it has proven very satisfactory.

Double-row deep-groove ball bearings, Fig. 1, are in effect two single row bearings side by side and have great capacity both for radial and thrust loads. They are used quite generally when the loading is more than permitted by the single row type.

The single-row, angular contact bearing type is good only for thrust in one direction, while the double-row type, Fig. 2, which is basically two single row bearings back to back, can carry thrust in either direction. Two single-row angular contact bearings are frequently matched, and the faces of the races ground by the bearing manufacturer so they can be used in tandem for large one directional thrust loads, or back-to-back, Fig. 4, for two directional thrust loads. In some cases, the two bearings are locked together by recessing the inner races and pressing them on to a short ring.

Single-row, angular-contact ball bearings can only be used singly on centrifugal pumps when the thrust is always in one direction. Thus, its use is limited primarily to vertical pumps. Another application is the use of two such bearings in an end suction pump to take care of the axial thrust in both directions. This arrangement permits a certain amount of axial adjustment of the impeller by loosening one bearing nut and tightening the other. Such adjustment is delicate and requires a first class mechanic.

Double-row bearings, or the equivalent of a matched pair mounted back-to-back, have been found very satisfactory where there is a possibility of a high thrust load in either direction. Some pump manufacturers standardize on this double-row angular-contact type for combined radial and thrust bearings for centrifugal pumps.

Ball Bearing Lubrication

In the layout of a line of centrifugal pumps, the choice of the type of lubricant is dictated by the application, by cost, and perhaps by the preferences of the purchasers.

For example, vertical wet pit condenser circulating pumps should have water lubricated bearings. If oil or grease leaked into the pumping system, the condenser operation might be seriously affected.

Lines of centrifugal pumps for refinery service are supplied with oil lubricated bearings because of the insistence of the refinery engineers for this feature. In the marine field, on the other hand, grease lubricated bearings are preferred. For very high pump operating speeds, 5000 rpm and above, oil lubrication is found to be most satisfactory. For highly competitive lines of small pumps, the main consideration is lubricant cost.

Ball bearings used in centrifugal pumps are generally grease lubricated. When grease lubrication of bearings is used, it is packed into the bearing; then the rotation of the balls throws it out and creates a slight suction at the inner race. Even though the grade of grease used for the lubrication of ball bearings is relatively light, it is a semi-solid and flows slowly. As heat is generated in the bearing, the flow of the grease is accelerated. This grease is then thrown from the outer race by the rotation of the balls and is cooled by contact with the housing. There is, therefore, a continuous circulation of

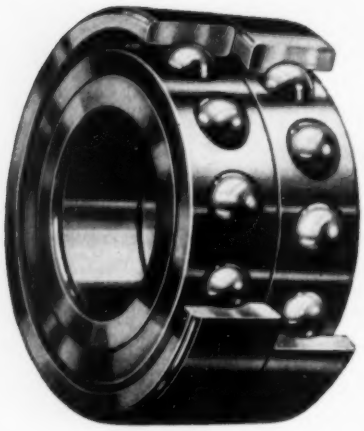


Fig. 4—These two single row, angular contact ball bearings are mounted back to back to handle two-directional thrust loads.

the grease. This method of lubrication requires the minimum amount of attention and has proven very satisfactory.

Housings of bearings of vertical pumps require seals to prevent the escape of the lubricant, and grease is generally preferred as there is less chance of leakage.

Grease lubricated ball bearings should never have the housing fully packed with grease. It is recommended that the void spaces in the housing be 1/3 filled with grease. An excess amount of grease will cause the bearing to heat, and grease will flow out of the seals to relieve the pressure. Unless the excess grease can escape through the seal or through a relief cock the bearing may fail.

When a ball bearing is oil lubricated, it becomes necessary to provide an adequate method for maintaining suitable oil levels at the bearing. The level of the oil should be at about the center of the lowest ball in the bearing when the unit is stationary. This may be accomplished by a dam to maintain the proper oil level and an oil slinger to maintain the level behind the dam and so increase the leeway in the level at which the operator must keep the oil in the bearing housing.

Water Cooling

Every bearing when in operation generates heat, the amount depending upon the load on the bearing and the rotative speed. The heat must be dissipated either to the surrounding air or through some other medium. If the amount of heat generated is too much for air cooling, water cooling becomes necessary. Thus, thrust bearings are more frequently water cooled than line bearings. This can be accomplished by circulating water (or other cooling liquid) through a jacket surrounding the bearing. There are a few installations where pump bearings are cooled with air forced through ducts in the bearing housings. With pumps handling hot liquids, heat from the interior of the pump may be transmitted to the bearing housings, thereby adding to the problem.

Sleeve Bearings

While anti-friction bearings have replaced the sleeve bearing in the majority of centrifugal pump designs, there still remains a very large field of application. The sleeve bearing is frequently used for reasons of economy. Some of the small inexpensive centrifugal pumps used strictly for pumping clear liquids are provided with an internal sleeve bearing, as illustrated in Fig. 3. An internal sleeve bearing depends primarily on the liquid pumped for its lubrication, and a water seal is sometimes used in the center of the bearing and connected to the pump discharge so that liquid is introduced under pressure.

At the other extreme, sleeve bearings are used for heavy duty pumps, when the shaft diameter reaches proportions such that anti-friction bearings are not available or may be considered less reliable at the operating speeds involved. High pressure boiler feed pumps designed for pressures of 1800 psi and above, operating at speeds of 3600 rpm, and having shaft diameters of over 3 in. at the bearings use this type.

For heavier duty applications, line sleeve bearings are generally of the self-aligning type. This may be accomplished by providing the bearing shell with a spherical fit in the bearing housing. An equally satisfactory solution, and one which results in a shorter bearing and shorter bearing span, consists in reducing the length of the bearing bushing engaged in the housing. This permits the bearing bushing to rock slightly in its seat to compensate for changes in angular position of the shaft.

The simplest form of sleeve type bearing used to carry a thrust component incorporates a babbitted shoulder in the bearing shell, a collar or shoulder being provided on the shaft to ride against it. Lubrication is supplied under pressure. A more refined construction, used very widely in the past under the name of "marine type thrust bearing" incorporates the use of as many as three to five collars on the pump shaft. One shortcoming of this type of construction is that it cannot compensate for the angular displacement of the shaft under deflection.

Kingsbury Thrust Bearing

The Kingsbury bearing is designed to prevent this breakdown of oil film. Suppose that first a circular collar is

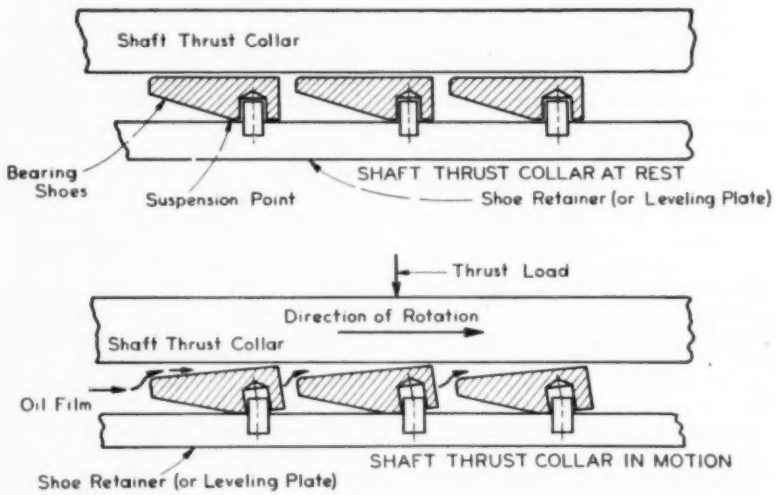


Fig. 5—This schematic diagram shows the principle of the Kingsbury thrust bearing. The idea is to prevent the breakdown of oil film. Each segment is supported on its under side, permitting it to rock slightly as shown.

cut into little segments. Each block is suitably supported on its under side to permit it to rock slightly on its suspension point, suitable means having been provided to retain these blocks in location. When the rotation of the shaft begins, there is a tendency for the film of oil to be dragged in under the slightly rounded edges of the blocks. As the speed increases, this tendency increases, the block adjusting itself slightly by tipping at a greater angle, and a certain action of riding up on the oil film takes place which can be likened to that of a sled-runner riding up as it meets the surface resistance of snow underneath. (Refer to Fig. 5). The higher the speed the greater this tendency to rock forward, permitting an increased "sledding" action and an increasing tendency of the shaft to adjust itself to the increasing oil film being dragged under. Construction details of a typical Kingsbury bearing can be examined closely in the sectional assembly shown in Fig. 6.

Tests of Kingsbury bearings show them to be capable of taking care of unit thrust loads and high linear speed far in excess of the ordinary straight collar thrust bearing. Their cost is relatively high and their use, except where extreme thrust conditions are present, may not be warranted.

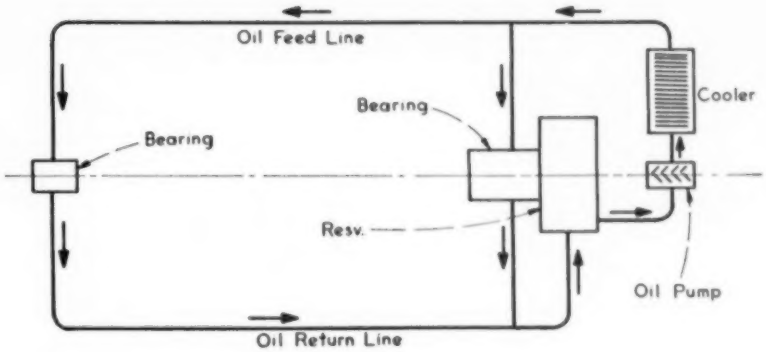


Fig. 7—Lubrication system is the one used on the bearing shown in Fig. 6.

Except at relatively low operating speeds, where splash lubrication or lubrication by means of oil rings may prove to be satisfactory, a provision for automatically circulating the oil and—where necessary—for cooling it, is an essential feature of all sleeve bearings. In the bearing shown in Fig. 6, the oil circulation is effected by a rotary positive displacement gear pump directly connected to the outboard end of the pump shaft by means of a flexible coupling. The oil pump takes the oil from a reservoir located either in the bearing housing or on the pump baseplate and delivers it through the cooler. From the oil cooler, the lubricating oil flows to the outboard thrust bearing from which it overflows into the reservoir located in the lower half of the bearing housing. It overflows by gravity from this reservoir into the main reservoir on the baseplate. This lubricating system is illustrated in Fig. 7.

There are numerous alternate methods both for supplying the bearing with forced feed lubrication and for cooling the oil. Some arrangements use a vertical oil pump driven from the main pump shaft by means of a worm gear. Other bearings employ the Kingsbury pumping ring which surrounds the thrust collar and dips into the oil bath. Oil clinging to the periphery of the collar is carried around inside the pumping ring and is forced into the thrust bearing cavity and the journal bearing.

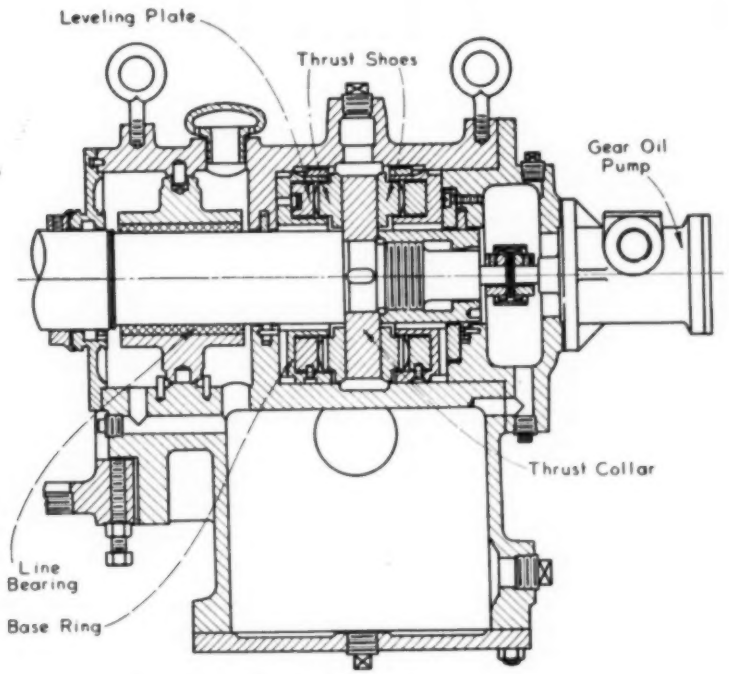
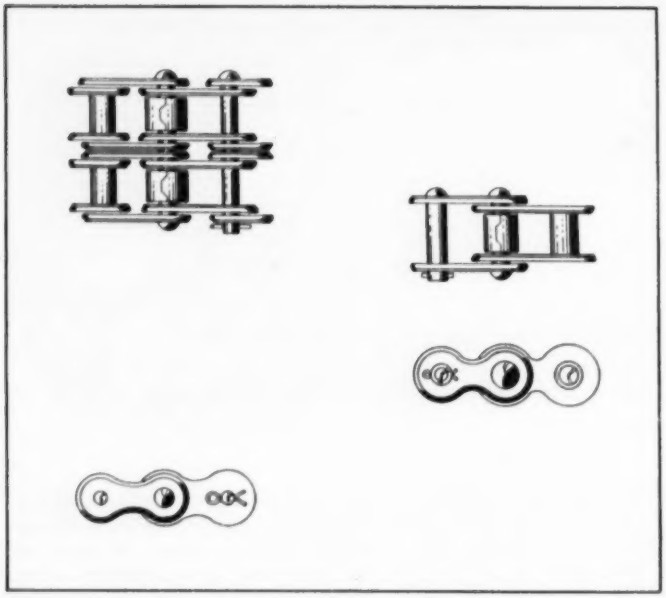


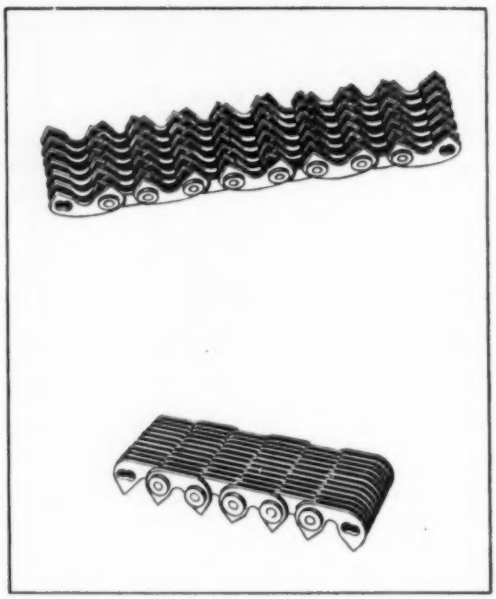
Fig. 6—A Kingsbury bearing is here shown in cross section as installed on a centrifugal pump shaft. This type of bearing is capable of handling thrust loads and linear speeds far greater than collar thrust bearings.

Oil Rings

The use of oil rings for line sleeve bearings normally supplied with oil under pressure is optional and not always justified. Their function is basically that of supplying oil to the bearing at the start of the pump operation, supposedly before the forced lubrication system has had the time to start. However, it should be remembered that sufficient oil is generally retained in the bearings to take care of the almost infinitesimal time lag before delivery of oil under pressure takes place. In addition, all properly designed oil lubricating systems incorporate an auxiliary oil pump, manually operated and intended to be used at scheduled intervals when the main pump is standing idle, to insure that oil does not drain completely from the bearings and from the oil piping. Operation of such an auxiliary oil pump at weekly or bi-weekly intervals is generally sufficient.



Precision roller chains come in single and multiple widths. Pins and bearings are case-hardened. Rollers are treated alloy steel.



Silent chains are precision made for quiet operation and good efficiency at higher speeds.

Transmitting Power . . .

Consider Chains

WILBUR G. HUDSON

Consulting Engineer

FEW MEDIUMS of power transmission possess quite the versatility of roller chains. The limitations of center distance, speed ratios, horsepowers, and operating temperature make it difficult for other power transmission methods to be as broad in their application.

Roller Chain Drives

The precision steel roller chain is favored over the short pitch malleable iron chains for conditions of moderately high speed and heavy duty. Because the precision roller chain is made to accurate pitch, giving smooth sprocket action; and because its weight per pound of rated pull is low; this chain is recommended for speeds up to 1200 feet per minute. The following data illustrate differences between common chain types:

Type	Pitch	Ultimate strength	Weight per ft
	in.	lb	lb
Heavy Ewart	4	9000	6.40
Pintle	4	34,000	5.70
Precision	1½	34,000	3.73

Precision roller chain drives are made in single and multiple widths. Pins and bushings are case-hardened. Rollers are heat-treated alloy steel. Chains of relatively short pitch, in multiple widths, operating on sprockets with a large number of teeth, are best for high speed and high horsepower requirements. They generally will assure smoothness, durability, and quiet operation.

Silent Chains

Silent chains are specifically designed for speeds above 1200 feet per minute. They will run well from a pinion on an 1800 rpm motor shaft. These silent chains have advantages which develop with use. Pitch wear is such that the character of the con-

tact with the sprocket teeth is retained even after the chain is well worn with long use.

Silent chain drives with an odd number of teeth in the pinion, but with a minimum of 17 teeth, are recommended for long wear and smooth performance. The sprocket centers must be spaced at a distance more than half the sum of their diameters. A center distance equal to the diameter of the large sprocket plus half the diameter of the pinion is good practice. The chain length should provide an even number of pitches to eliminate the use of an offset coupler link. The use of shorter pitch and wider chains, with a minimum of 25 teeth in the faster running wheel, and a conservative horsepower rating, favor silent operation and long service with minimum maintenance.

Chain Wear

The roller chain consists of a series of roller assemblies connected by side bars. As the chain wears, the distance from the surface of one roller to the surface of the roller in the next assembly link is affected as the pins and bushings become worn. Eventually, the worn chain's uneven alternate lengths and pitches cause rough sprocket action and noisy operation. However, with reasonable care and attention to lubrication, the chain should last a very long time in service.

The sprockets for chains may or may not be hardened. With the silent chain, hardening has the advantage of maintaining the profile of the teeth. For the roller chain, it is better not to harden the teeth because of the staggered pitch wear effect. It is also better to have an even number of teeth and an even number of chain pitches so that there is a compensating wear in the sprockets as the alternate pitches increase.

In high speed chain drives it is advisable to use a layout that minimizes the effects of wear on performance. Fig. 1 illustrates some simple examples of good and bad drive arrangements commonly practiced.

Lubrication

Where high speeds and heavy loads are involved, lubrication becomes important. Over-lubrication causes oil-friction and heating, though not to the extent that it does with gear drives where there is a trapping effect as the gear teeth mesh. Chain drive housings must be dust and moisture proof or the value of the lubricant is seriously reduced. Lubrication may be by the splash method, where the chain dips about ½ in. into the oil reservoir; or by forced lubrication, where a small pump circulates the collected oil after it has been sprayed directly on the chain and so cools the lubricant for re-use in the system.

Where the drive operates in temperatures from 30 to 100 F, SAE 30 oil is indicated. For temperatures below 30 F, a lighter oil should be used, and for high temperatures, SAE 40 or 50 is recommended. In climates with seasonal extremes, light winter oils should be drained and replaced with heavier oils for the summer weather conditions.

Advantages and Limitations

The alternative to the chain drive is the multiple V-belt. The V-belt can be operated at speeds far higher than desirable for chain drives. Its elasticity makes it a better transmission medium where heavy shock is involved or where one or both shafts are subject to continuous vibration. The favorable features of the chain drive are that it is detachable and readily replaceable when worn or when a speed change is desired. It has space economy, permits small sprocket diameters, is not affected by atmospheric changes, and runs slack except that portion transmitting the load. The detachable feature may be the deciding factor in favor of chain drives if one or both wheels are mounted between bearing supports so that dismantling would be necessary in order to replace a V-belt.

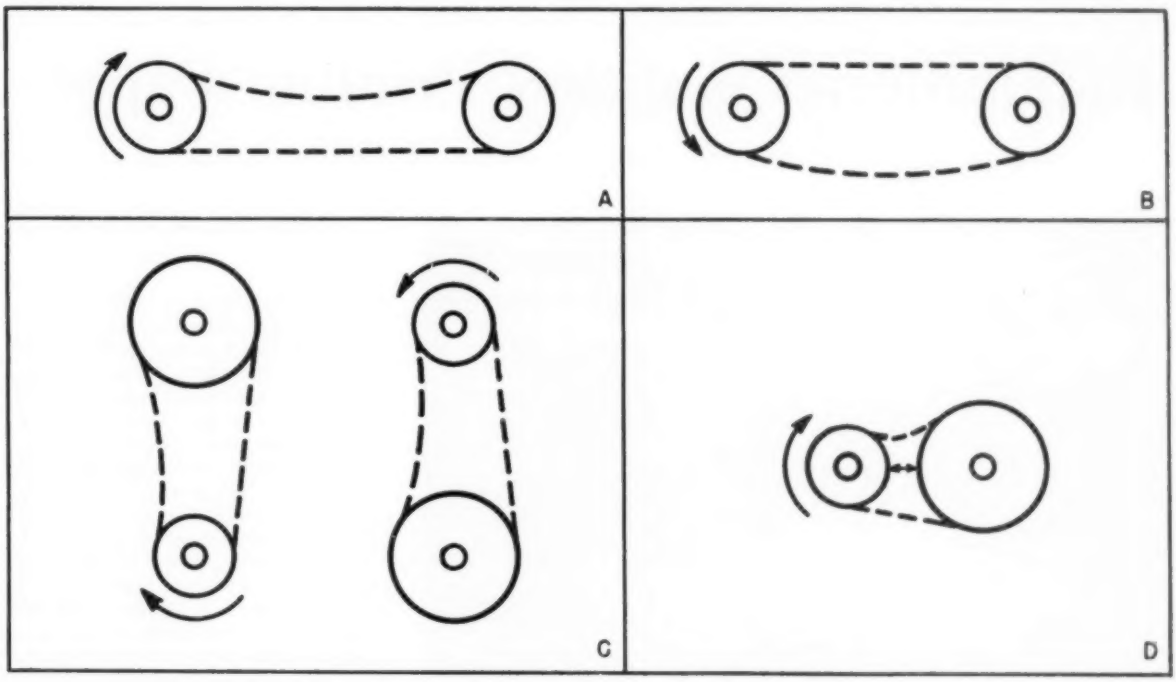
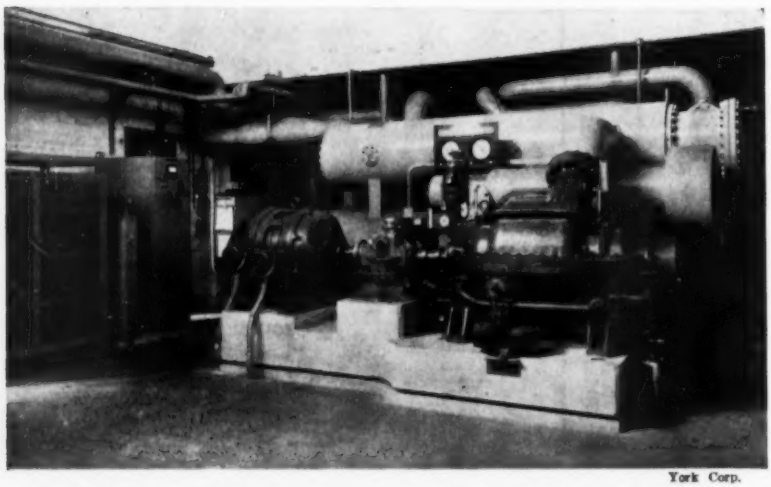


Fig. 1—Inset B, as opposed to A, is good practice where small sprockets can cause the slack strands to strike together. In example C the drive sprocket should be above as at right. Inset D is poor as slack allows the chain to be pinched.

Walton Laboratories

Walton system unit humidifiers used to maintain constant relative humidity in the stock room of a printing establishment.

Humidifiers Condition Printing Paper



York Corp.

A York 220 ton turbo-compressor used in the air-conditioning system in the printing plant of the Gospel Publishing House in Springfield, Missouri.

FRANCIS A. WESTBROOK

THERE HAS BEEN a recent increase in the demand for air-conditioning in the industries handling hygroscopic materials, of which the printing industry serves as an excellent example. Helped by the development of new and relatively inexpensive equipment, the application of temperature and humidity control is spreading rapidly, even among the smaller printing establishments.

Because most paper is made of wood fiber, which is hygroscopic, a sheet of paper will absorb or give off moisture with changes in ambient relative humidity. Either of these actions may take place very quickly; 90 per cent of the change probably takes place in the first ten minutes or less

of exposure. It follows, of course, that the swelling and shrinking of the fibers causes dimensional changes in the paper. And with the high speed printing processes now employed, slight variations in the size of a sheet of paper may be very troublesome and may make good work impossible. This is particularly true for modern lithographic printing which calls for close register at all times.

While it is not practical to reform the cellulose structure of paper, it is possible to control temperature and humidity. By holding relative humidity to proper levels in storage, printing, trimming, folding and piling, it is easy to counteract the objectionable gain or loss of moisture. Recommended relative humidities for printing plants as given by the *Heating & Ventilating Guide* are listed in the accompanying Table 2.

Static electricity, generated by the movement of paper through the presses, may cause difficulties. Sheets stick together or stick to the rolls because of static. And then there is the potential threat of fire caused by a static spark. Experience and careful analysis indicate that with relative humidities of 50% or more, an invisible film of water forms on all objects, including the press itself. This film of water helps ground the static.

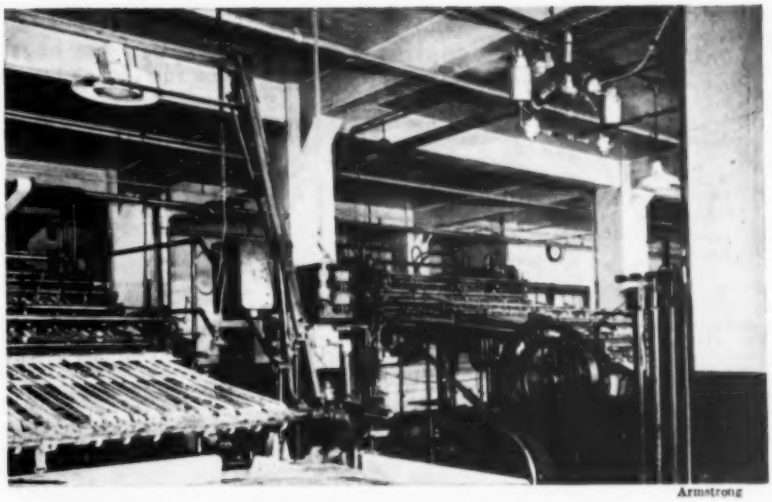
Roller Variations

Composition rollers are also subject to variations in moisture content due to changes in relative humidity. The diameters expand and contract with changes in moisture content of the air. In either instance, there is a drag which wears the surface of the rollers, gives improper ink distribution, and wears both type and halftone plates. Proper uniform relative humidity gives the rollers better shape, less expansion and contraction, better ink distribution and life.

Ink Drying

Inks dry chiefly by oxidation or by absorption. In either case they are particularly sensitive to changes in relative humidity and temperature. Inks printed on paper having a high moisture content may appear to lack full color; if printed on a dry paper, they may crystallize or fail to print clearly. If printed on paper containing considerable moisture, inks which dry by absorption may smudge. Metallic inks are being used more and more, and they act very erratic if proper moisture and temperature conditions are not maintained at all times.

It is for these reasons that the printing industry is quickly adapting air-conditioning and humidifying equip-



Armstrong

Armstrong humidifier reduces production losses due to static electricity on printing presses at Nazarene Publishing Co., Kansas City, Missouri.

Bahnson

This Bahnson Humiduct installation runs the full length of the press room with openings at regular intervals to permit the entrance of moist air into the area.

Westinghouse

Westinghouse Unitaire conditioner (at far left) in a press room with one Miehle two-color press. This unit is especially useful where space is limited.

TABLE 1 — THE MOISTURE CONTENT OF DIFFERENT KINDS OF PAPER AT 75 F AND EXPOSED TO AIR WITH RELATIVE HUMIDITY RANGING FROM A LOW OF 10 PERCENT TO A HIGH OF 90 PERCENT

Material	Description	Relative humidity, percent								
		10	20	30	40	50	60	70	80	90
M. F. newsprint	Wood pulp 24% ash	2.1	3.2	4.0	4.7	5.3	6.1	7.2	8.7	10.6
HMF writing	Wood pulp 3% ash	3.0	4.2	5.2	6.2	7.2	8.3	9.9	11.9	14.2
White bond	Rag — 1% ash	2.4	3.7	4.7	5.5	6.5	7.5	8.8	10.8	13.2
Commercial ledger	75% rag 1% ash	3.2	4.2	5.0	5.6	6.2	6.9	8.1	10.3	13.9
Kraft wrap	Coniferous	3.2	4.6	5.7	6.6	7.6	8.0	10.5	12.6	14.9

(Authority — U. S. Bureau of Standards)

ment to its needs. A humidifier designed to deliver a pre-determined water mist into the room air and so keep the relative humidity from dropping too low is manufactured by the Armstrong Machine Works. Their Type C-2 and C-3 humidifiers use a small electric fan to disperse steam throughout a room. Their large CK-4 and DA-34 humidifiers are installed in a heating or air-conditioning duct or in connection with a large floor-type unit heater. The Bahnson Company's Humiduct unit, serves a similar purpose.

Westinghouse makes a packaged air conditioning unit designed to condition a comparatively small space. In this application a Miehle two-color press has been installed in a room just large enough for the one piece of equipment. There is no ductwork, and the unit, in the form of a good sized cabinet, is easily moved from one location to another. It is relatively inexpensive and suitable for the smaller lithographic printers. York and other concerns also make packaged air-conditioning units suited to this type of application.

A very up-to-date and complete air-conditioning job was recently completed by the York Corporation for the Gospel Publishing House in Springfield, Missouri. This new plant has two floors. The ground floor is used to store paper, books, and magazines. The press and folder room, composing room, bindery, proof reading room, and the subscription room are on the upper floor. Both floors are completely air-conditioned to meet the specific temperature and humidity requirements in each department.

The entire plant is served by a 220-ton turbocompressor complete with water cooling system, cooling tower, condenser, chilled water pumps, steam converter, and centralized controls. These are located in a modern boiler house which is connected with the printing plant by a long pipe tunnel in which run the steam, condensate, and chilled water lines. Both the power house and the tunnel have been made large enough to provide for future growth.

There are four large air conditioners in the printing plant with air washers which were assembled on the job. Two small factory assembled units mounted on the ceiling form the "low side" of the system. The same coils and piping are used for both summer and winter conditioning; hot water is pumped through them in winter and chilled water in summer. Heating to cooling changes are made automatically by pneumatic control apparatus in the boiler house.

Area Control

An interesting feature of the installation is the use of steam grid humidifiers and steam reheating coils. This makes it possible to independently control the relative humidity in different sections of the plant.

TABLE 2 — RECOMMENDED RELATIVE HUMIDITIES FOR PRINTING PLANTS AS GIVEN BY THE HEATING & VENTILATING GUIDE

Process	Degrees Fahrenheit	Relative humidity
Binding	70	45
Folding	77	65
Printing	75	50 - 60
Storage	75 - 80	40 - 60

Distribution ducts have adjustable louver dampers for the side grilles. These ducts have been installed as inconspicuously as possible. At the same time they have been placed so as not to interfere with the sprinkler system and so that the air flow will not be impeded by the fluorescent lights.

In the press room it was found desirable to use large ceiling diffusers for the conditioned air, to prevent its blowing directly upon the paper in the presses.

Installation

When considering the installation of any air conditioning system in a printing plant, it should be borne in mind that it must, to be satisfactory, be designed to meet the local conditions. These include the climate of the locality where the installation is made and the materials and processes involved. There are numerous manufacturers of air conditioning equipment and contracting concerns which can give reliable advice and as this is a highly specialized subject it will practically always be advisable to consult with at least one of them.

Controls are extremely important. Paper either too wet or too dry will not run properly, and there is even a difference in relative humidity required for different processes within the printing plant. Controls should be accurate enough to maintain within two or three percent the relative humidity desired.

Wherever well designed air conditioning and humidifying systems have been installed in printing plants and paper storage warehouses, immediate results have been observed in better running of paper in the presses and improved appearance of the print work.

Paper is just one example of hygroscopic materials which require control of the ambient air to put them into optimum condition for processing. While different temperature and humidity conditions are required for working other hygroscopic materials, the same principles of moisture and temperature control apply.

NEW SOLNUS OILS GIVE YOU MORE LUBRICATION PER DOLLAR

New Multimillion-Dollar Plant Producing Better General Lubricants at Moderate Prices

They can be used for lubrication of plain bearings, antifriction bearings, linkages, slides, cams and gears; in gear boxes, hydraulic systems, circulating systems, industrial diesel engines, compressors.

They can be used for longer periods because they resist oxidation, prevent rusting and corrosion.

They can be applied by every method used in the general lubrication of industrial machinery.

They have low carbon content In compressors, for instance, any carbon that does form is soft and fluffy, is easily blown off, does not build up.

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INDUSTRIAL PRODUCTS DEPARTMENT
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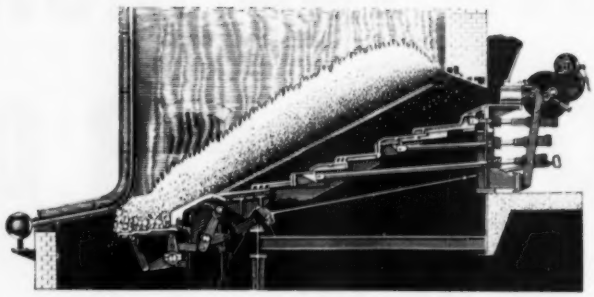

TAYLOR UNDERFEED STOKER

5 ways better than aspirin

FIVE DIFFERENT HEADACHES have often been inseparably connected with stoker operation... and every one of them is eliminated by the modern, engineered AE Taylor Stoker.

CO_2? That's where Taylors give you unrivaled efficiency. *Quick load response?... complete dependability?* Taylor Stokers are completely tops in both respects. *Stack discharge nuisance?* Taylors meet the toughest municipal ordinances. With proper grate area, over 98% of the ash goes to the pit. *Burning versatility?* Properly proportioned, Taylors can and do burn coals satisfactorily from all over the U.S., and from Canada, England and the Continent as well.

Whether your new plant must generate 20,000 or 500,000 pounds of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us today for booklet telling the whole Taylor story.

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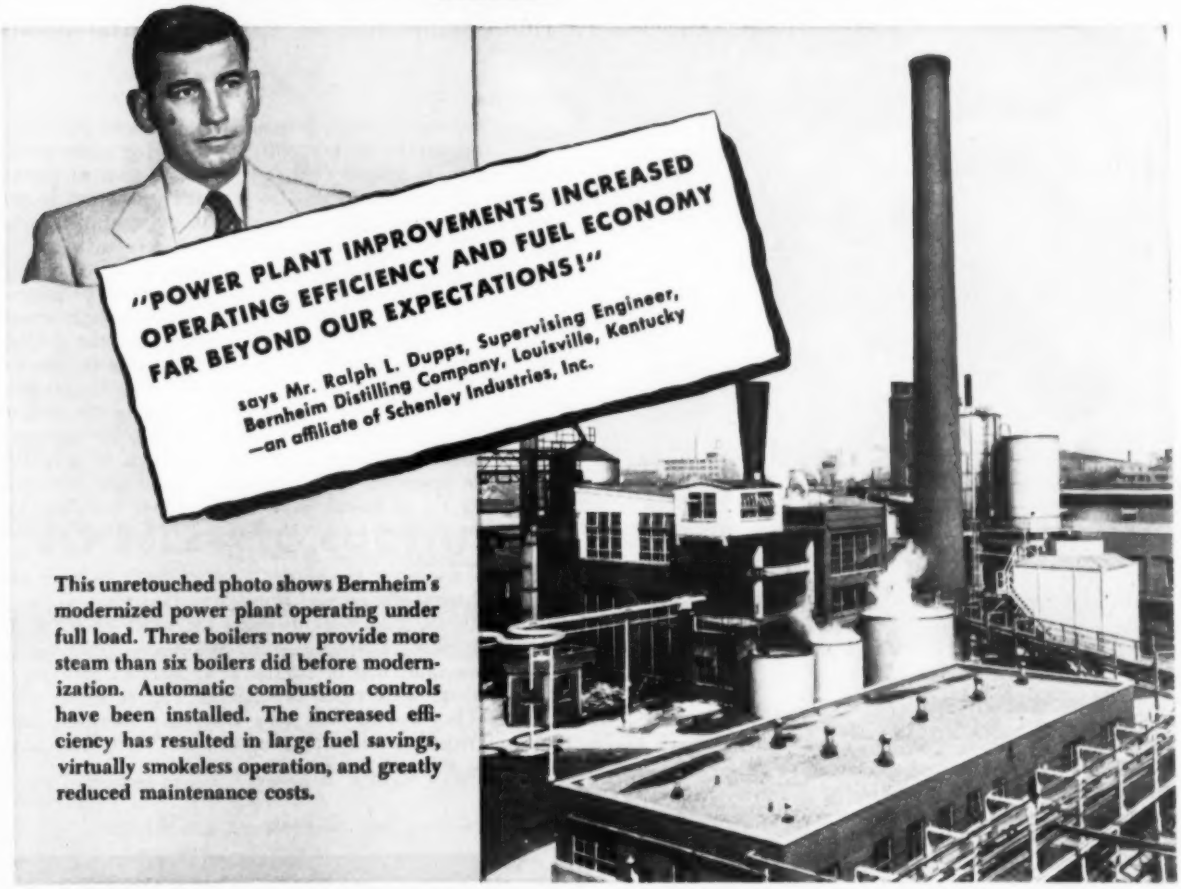
IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

"WE CUT OPERATING COSTS $67,000 A YEAR— BY BURNING COAL THE MODERN WAY!"


"POWER PLANT IMPROVEMENTS INCREASED OPERATING EFFICIENCY AND FUEL ECONOMY FAR BEYOND OUR EXPECTATIONS!"
says Mr. Ralph L. Dupps, Supervising Engineer, Bernheim Distilling Company, Louisville, Kentucky —an affiliate of Schenley Industries, Inc.

This unretouched photo shows Bernheim's modernized power plant operating under full load. Three boilers now provide more steam than six boilers did before modernization. Automatic combustion controls have been installed. The increased efficiency has resulted in large fuel savings, virtually smokeless operation, and greatly reduced maintenance costs.

Why not take *full* advantage of coal's economy? Cut your operating costs to a minimum with automatic coal- and ash-handling equipment. Get more steam for every dollar with an up-to-date combustion installation.

Whether you're building a new plant, or planning to modernize, a consulting engineer can show you how you can get big savings by burning coal in a modern plant designed to meet your *specific* needs.

Consider, too, that of all fuels, coal alone has virtually unlimited reserves. And America's coal industry leads the world in efficient, economical production. That means that, unlike other fuels, ample coal will be available in the future—and at relatively more stable prices.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE

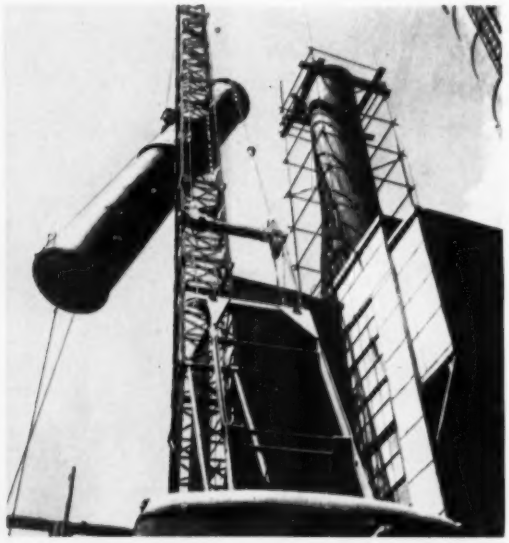
A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY & FOR LOW COST

YOU CAN COUNT ON COAL!

spot news

. . . what's happening in U. S. industrial plants



Glass Lining Combats Corrosion of Steel Stacks

Corrosion, caused by acid condensate in smoke, is an important factor in shortening the life of industrial steel stacks. It has been estimated that over 5000 steel stacks are replaced annually in the United States.

To combat this condition, A. O. Smith Corp. reports that it is conducting research on the use of fused glass linings. For some time, this company has been fusing glass to steel in the manufacture of vessels ranging from water heaters to huge beer storage tanks.

Employing techniques developed in its ceramics laboratory, the company coated both inside and outside of a 44 ft stack section with acid-resisting linings of approximately .005 in. thickness. It will be used to form the top section of an 85-ft powerhouse stack at the company's Milwaukee plant. The 3-ton section is shown being hoisted into position.

Agreement Permits American Firm To Use Swiss Boiler Designs

To continue the trend toward lower electrical power production costs in the face of rising fuel costs, designers are continually leaning towards the use of higher steam temperatures and pressures. Of particular significance at this time, because of the interest in pressures above the so-called critical pressure of 3206 psig, is an agreement between Sulzer Bros., Ltd. of Switzerland, and Combustion Engineering, Inc.

Under this agreement, Combustion Engineering will manufacture and market a once-through type boiler known as the Sulzer Monotube steam generating plant. Monotube units have long been built by Sulzer Bros., and a number of high pressure installations have been rendering satisfactory service in European countries for many years.

In order to achieve further appreciable gain in power station economy, designers feel it will be necessary to go considerably beyond the critical pressure point. At pressures above this point, conversion of water to steam is instantaneous, thus skipping the intermediate bubbling phase which characterizes transition below critical pressures.

Although design pressures for the once-through steam generators presently used in Europe are below the critical point, the principles of the Sulzer units provide the means of building plants operable at pressures up to 10,000 psi. Combustion Engineering is presently planning the design of a 5000 psi, 1200 F unit, rated at 200,000 kw capacity. In comparison, the highest design conditions of a boiler actually in operation anywhere in the world are 2650 psi and 1100 F., as found in a unit recently installed by Combustion Engineering in the Kearny, N.J. power station of Public Service Electric & Gas Co.

Design engineers expect the 5000 psi unit to have an over-all thermal efficiency of from 42 to 43 percent, as compared with the maximum thermal efficiencies of between 36 and 37 percent achieved in today's units.

The new units will be similar in appearance to today's large boilers, with tubes as high as 150 ft lining the furnace. They will be built more compactly, however, and will not require steam separating drums. Water recycling equipment also will be simplified.

Porcelain Enamel Coating Extends Life of Thermocouple Protective Tubes

Barrows Porcelain Enamel Co. has reported that, through the use of porcelain enamel coating, the life of thermocouple protective tubes has been extended from an average

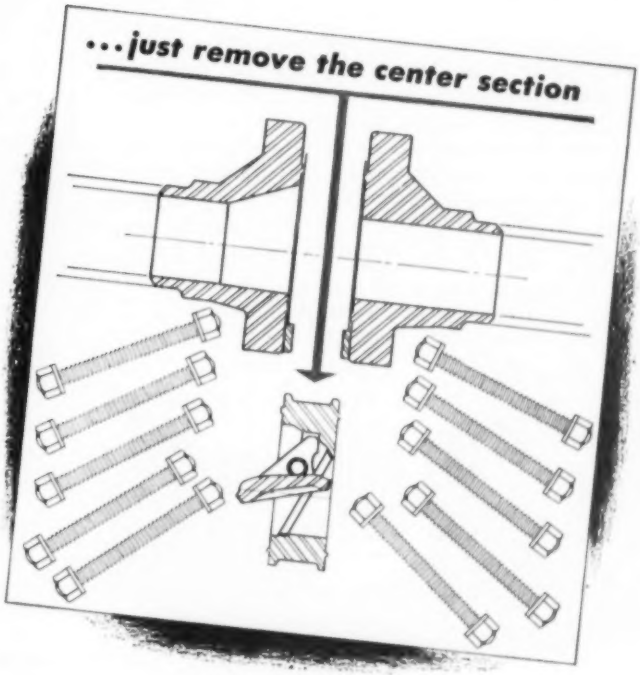
(Continued on page 88)

NO NEED to cut this valve out of a Welded Line

...it's a CHAPMAN 3-PIECE TILTING DISC CHECK VALVE

Remove studs between inlet and outlet ends. Then the whole center section can be slipped out *as a unit* . . . and quickly and easily replaced. Figure the savings for yourself!

Here, Chapman design gives you the smooth operation and quiet closing of the 2-piece Tilting Disc Check Valve . . . with the unique advantage of practically immediate interchangeability of "the works." And *only* Chapman makes this complete line of Tilting Disc Check Valves. Send for your Chapman "Check Book" — *now!*



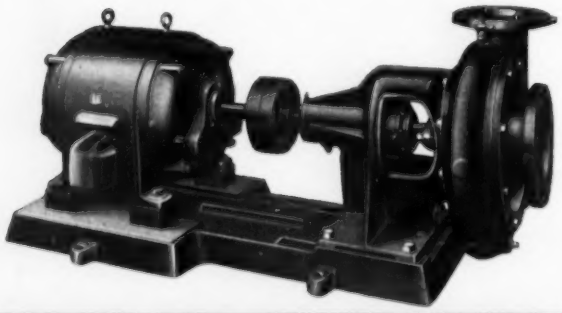
The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

for plumbing ...call a plumber

for pumps ...call a WEINMAN PUMP SPECIALIST

To get a job done right, it's best to call a specialist. WEINMAN specializes in building and supplying pumps that are right for your needs. That's because WEINMAN is dedicated to service, and for more than 50 years, has helped industries find a practical solution to their liquid handling problems. WEINMAN makes only one product . . . centrifugal pumps. The experience and know-how behind their basic designs, and modifications of them, assure you of dependable results.

So, if pumping is a problem in your plant . . . call a Pump specialist . . . a WEINMAN MAN. Write, wire or phone him . . . TODAY.



Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

286 Spruce Street • Columbus 8 • Ohio

spot news

(Continued from page 86)

of 160 hours for uncoated types, to an average of between 450 and 500 hours. In addition, costs of replacing thermocouples have been reduced since a new unit is needed each time a protective tube fails. The thermocouples cost approximately as much as a protective tube.

Cast iron, from the bottom of the tube to the hot metal line, provides the base for the porcelain enamel coating. W. A. Barrows, president of the Barrows company, is shown in the illustration examining coated tubes manufactured to protect thermocouples during aluminum manufacture. Units of this type are mass produced by Barrows for Reynolds Metal Co., and other producers and melters of low temperature metals.

Laboratory Will Make Design Study Of Single Purpose Reactors

Another step on the road to peacetime utilization of atomic power has been taken by the Atomic Energy Commission. In its latest contract calling for design studies by private industry, the AEC has commissioned Walter Kidde Nuclear Laboratories, Inc. to make a study of "a nuclear power plant for use in an isolated high-cost power area."

The study will concentrate on a "single purpose" reactor of 30,000 kw capacity. This type of unit is generally defined as a reactor designed specifically for a single purpose — in this case, the production of power. In comparison, "dual purpose" reactors which have recently been widely publicized as a result of a number of surveys made by private industrial concerns, provide for the production of plutonium and power as co-products. It is proposed that the plutonium would then be sold to the government for use in the weapons program.

An "isolated high-cost power area" is defined as a place where electrical power is not readily accessible at usual costs. Examples include uninhabited desert areas where power may be needed for industrial development, and off-shore locations where conventional fuels will not permit economical power generation.

The contract between AEC and Walter Kidde calls for a detailed cost analysis to cover architect-engineer costs, construction costs, and operating costs for a four-year period following start-up of the plant. Also to be carried out under the contract is a study of the effects of site location upon reactor design and power cost. Completion of the study is scheduled for late 1953.

New Motor Frame Standards Permit Increased Horsepower

New broad standards allowing more horsepower to a frame size for all popular high production alternating current type electric motors from 1 to 30 hp, have been announced by the National Electrical Manufacturers Association.

The advent of superior synthetic insulating materials, new and better silicon steels, and improved techniques, as well as real advances in the art of motor design, are cited as developments which permit packing more horse-

(Continued on page 116)

Here's how this strainer "combs" itself clean!

This simple chalk test shows how AUTO-KLEAN's unique built-in comb construction cleans the strainer without costly interruption of flow

ORDINARY BLACKBOARD CHALK leaves heavy deposit of chalk particles on and between discs of Cuno AUTO-KLEAN strainer.

TURNING HANDLE ONE REVOLUTION moves strainer element through comb blades, removing all traces of chalk from between discs. Cuno's exclusive combing operation cleans *thoroughly* —without stopping flow.

FILTERING AREA IS COMPLETELY CLEAN, restoring full initial capacity. All chalk particles and dirt fall to bottom of housing where they can be drained periodically.

- AUTO-KLEAN's permanent metal filter element is available in steel, brass, or stainless steel for long, trouble-free service.
- AUTO-KLEAN is adaptable to any fluid-flow system.
- From acids to tar . . . if you can pump it, Cuno can filter it. Capacities range from one gallon per hour to 15,000 gallons per minute.

CUNO **ENGINEERED FILTRATION**
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

NON-STOP FILTRATION FOR ALL YOUR INDUSTRIAL FLUIDS

Continuously cleanable AUTO-KLEAN eliminates need for stand-by strainers

You don't have to shut down your fluid-flow system to clean this strainer. Cuno's exclusive "comb-clean" action provides complete cleaning of the element *—without stopping fluid flow.* Thus, you get non-stop filtration, with no need for a stand-by strainer.

Send your industrial fluids—chemicals, water, fuel and lube oils—through an AUTO-KLEAN. The low-pressure drop of AUTO-KLEAN strainers permits *full-flow* operation on gravity, low pressure, high pressure, or suction lines—with no loss in operating efficiency. AUTO-KLEAN's compact construction allows this continuous full-flow filtration in space which would limit ordinary filters to by-pass service.

Fixed-space metal discs in this modern strainer remove all solids larger than the specified disc spacing—from .0035" to .062".

The low maintenance costs of the AUTO-KLEAN save you money, for there are no cartridges to change. An occasional rotation of the handle does the cleaning job (most units can be equipped with motor-drives for continuous cleaning).

For permanent, positive fluid protection, install compact Cuno AUTO-KLEAN—the precision-built strainer. Send the coupon for free bulletin. A.3.4

Cuno Engineering Corporation
Dept. 144A, South Vine Street, Meriden, Conn.
Please send me bulletin on Cuno AUTO-KLEAN
Name.....
Company.....
Address.....
City.....Zone....State.....

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BUILDING MATERIALS & MAINTENANCE

200—Masonry Water Repellent

Discussed in a 4-page folder is an inorganic water repellent designed for brick, concrete, sandstone, stucco, asbestos cement combinations, cement base paints, and other composition surfaces. The bulletin explains how the product eliminates dampness on interior wall surfaces and lists many other advantages. The results of accelerated weathering tests are appraised. Flexrock Co.

201—Vacuum Cleaning Systems

Stationary vacuum cleaning systems are described in 8-page bulletin 121 B. In addition to applications such as cleaning of ceilings and walls, the booklet describes the cleaning of such industrial equipment as boiler tubes and filter screens. Various accessories are illustrated. The Spencer Turbine Co.

202—Interior Finishes

Color-chips illustrating a group of colors especially prepared to insure color harmony for plant interiors and machinery, are presented in 6-page folder 125. Suggested applications for each type of finish also are presented. Rust-Oleum Corp.

BOILERS & BOILER ACCESSORIES

203—Water-Tube Boiler

Described in 16-page brochure P-360 is a new packaged water-tube boiler. Following an introduction providing background information is a section outlining principle design features of the units, which are completely shop assembled and provide steam capacities from 4000 to 30,000 lb per hr. Design pressure is listed at 250 psi. Space requirements are shown in a table, along with typical specifications. A concluding section describes the automatic control system. Combustion Engineering, Inc.

204—Packaged Boilers

Packaged automatic boilers for light oil, heavy oil, gas, or combination gas and oil firing are featured in 16-page bulletin 1219. Design and construction details are pointed out in a large cutaway view. Factors contributing to long life and outstanding service are appraised. Ratings from 15 to 500 hp are listed in tables of specifications, and actual installations for steam process as well as for steam and hot water service are illustrated and described. Orr & Sembower Inc.

205—Water-Tube Steam Generators

Data and specifications for factory assembled water-tube steam generators in sizes ranging from 5300 to 33,000 lb per hr are presented in an 8-page brochure. The units, for pressures up to 400 psi, are designed to provide fully automatic firing with oil, gas, or stoker-fired coal. Cutaway views show construction features. Superior Combustion Industries, Inc.

206—Oil & Gas Burner

Described in 16-page bulletin ID53-162 is a factory-coordinated, industrial fuel burning system. Built around an industrial burner for oil or gas firing, the system includes proper controls mounted in panels and wired to terminal strips for easy connection, factory engineered windbox and refractory ring, fuel oil heaters, and trim. How the system works is fully described, and ease of installation is stressed. Construction features are shown, and specifications are listed. York-Shipley, Inc.

207—Coal-Burning Installations

"Burning Bituminous Coal the Modern Way," a 24-page booklet, presents numerous actual case histories from industries of all sizes and types. Engineering survey results and such equipment as boilers, stokers, coal and ash handling units, and automatic controls, are presented for each installation. Annual fuel consumption and operating costs also are tabulated. Bituminous Coal Institute.

ELECTRICAL EQUIPMENT

208—Motor Standards

New frame dimensions for a-c motors from 1 to 30 hp, as established by new motor standards passed by NEMA on May 19, are presented in 8-page bulletin GEA-5995. The publication compares the old with the new frame assignments for open-type polyphase, single-phase, and wound-rotor motor as well as totally-enclosed, fan-cooled types. Also listed are suggested new frame assignments for foot-mounted and flange-mounted motors, and standards for minimum locked-rotor torque for general purpose single-phase motors. General Electric Co.

209—Control Equipment

What to look for in maintaining control equipment is told in 8-page manual 14X-7612A, entitled "Proper Maintenance of Control." Besides giving helpful suggestions toward overcoming some of the most frequent difficulties common to most electrical control devices, the booklet presents a handy, trouble-shooting chart, showing the symptom, cause, and cure. A check list is included to aid in establishing a proper maintenance schedule. Allis-Chalmers Manufacturing Co.

210—Protective Relays

Principles of modern practice are explained in a new and expanded edition of "The Art of Protective Relaying," 72-page booklet GET-1768A. The literature contains information on types of relays used for protecting such apparatus as generators, transformers, and transmission lines. It outlines procedure for evaluating power apparatus and system characteristics to determine proper applications and settings of relays. It also gives a complete listing of available equipment with reference to detailed literature. General Electric Co.

211—Variable Speed Motors

How variable speed motors are used to improve production is described in 16-page brochure 1797. In addition to describing advantages, the booklet describes design theory and construction features. Special controls, including both mechanical and electrical types, also are discussed. U. S. Electrical Motors, Inc.

HEAT EXCHANGER EQUIPMENT

212—Heat Exchangers

Hot water storage heaters and heat exchangers are the subject of 16-page catalog 5. Included among the various types of equipment are horizontal and vertical hot water storage heaters, instantaneous water heaters, converters, condensate coolers, fuel oil heaters, and instantaneous suction heaters for viscous fluids. In addition to discussing applications and construction, the literature presents tables to aid the engineer in selecting proper equipment.

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NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 99.

For expansion or replacement

you get a better buy

with the

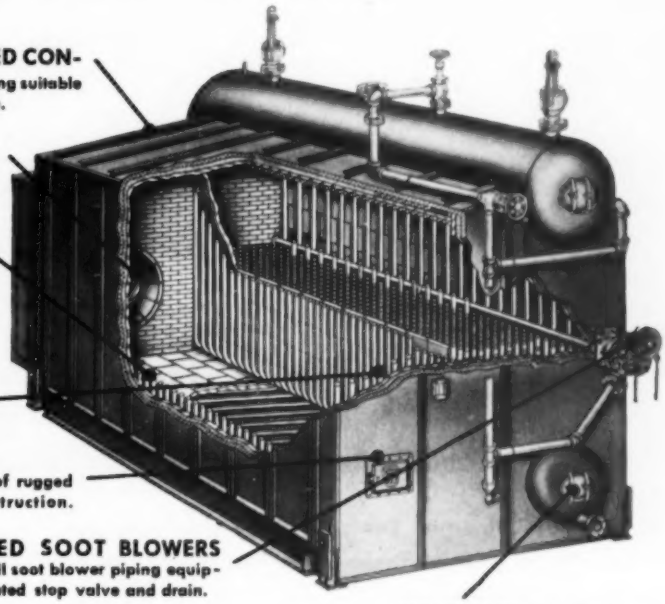
FW PACKAGE STEAM GENERATOR

If you are planning a new plant, expanding production or want greater efficiency through replacement of your present steam generator, it will pay you to "look into" the Foster Wheeler Package Steam Generator.

For process steam, heating, or "on-the-spot" construction steam, these highly efficient, plant-assembled, water-tube steam generators produce savings in installation, operation and maintenance. They are available in capacities from 7,500 to 35,000 lb of steam per hr. Design pressures are 250, 525 or 825 psi. Multiple-unit installations are practical and economical up to 150,000 lb per hr.

• • •

For low-cost steam "where you need it—when you need it", you get a better buy with the Foster Wheeler Package Steam Generator. For more detailed information, write to Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



ALL STEEL WELDED CONSTRUCTION of casing suitable for outdoor installation.

TWO BURNERS on units over 20,000 lb per hr. All burner registers are hinged to permit easy access to diffuser and register louvers.

FURNACE WATER WALLS backed with 2" first quality fire clay tile, 2" block insulation and 2½" rock wool blanket.

REAR FURNACE WALLS are water cooled for full height of furnace, tie in to boiler circulation without use of headers.

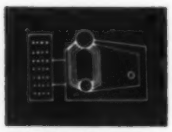
HINGED ACCESS DOORS of rugged refractory lined cast iron construction.

DOUBLE - ENDED SOOT BLOWERS on the larger units. All soot blower piping equipped with chain operated stop valve and drain.

MANHOLES at both ends of each drum for capacities in excess of 15,000 lb per hr.

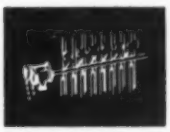
FEATURES THAT DISTINGUISH FOSTER WHEELER PACKAGE STEAM GENERATORS

HIGH STEAM TEMPERATURES. Provisions for superheaters in some designs.



ECONOMIZERS. For larger capacity installations, package economizers can be supplied to provide minimum fuel costs.

ACCESSIBILITY. For inspection, cleaning, maintenance.



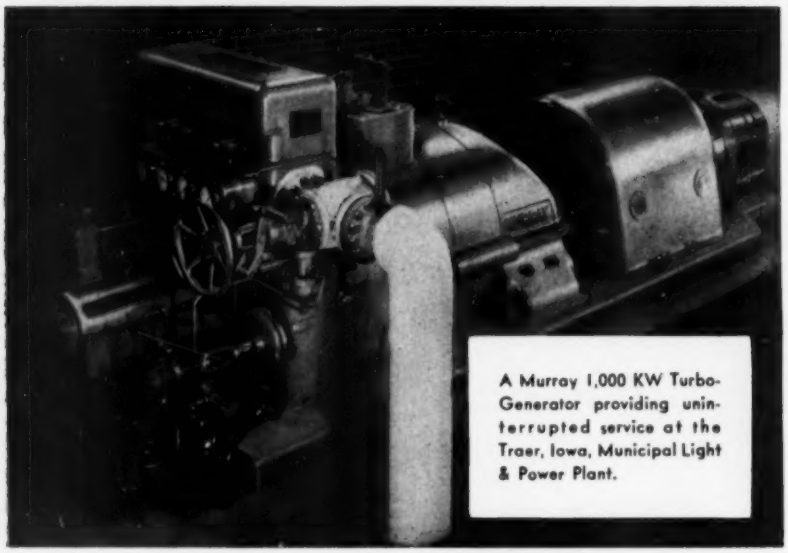
CLEAN HEATING SURFACES. Soot blowers incorporated . . . cleaning without boiler shutdown.

HEAT LOSS MINIMIZED. Minimum heat loss—from radiation and air infiltration.

RAPID LOAD SWINGS. Large diameter drums and ample furnace heating surface.

FOSTER WHEELER

Murray Turbines



A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a MUST.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

new bulletins

(Continued from page 90)

Typical examples are included to demonstrate use of the tables. Patterson-Kelley Co., Inc.

FANS & BLOWERS

213—Centrifugal Blowers

Design and performance features of multistage centrifugal blowers and exhausters for pressures from 1 to 9 psi, and vacuum from 2 to 12 in. of mercury, are appraised in 2-page data sheet A-932. Industrial applications are listed, including several in which savings can be made by replacing compressed air formerly considered necessary. Also included are typical performance and check lists of data required for optimum blower or exhauster specification. Air Appliance Div., U. S. Hoffman Machinery Corp.

FILTERS, STRAINERS, & PURIFIERS

214—Internal Downflow Purifiers

Featured in 4-page bulletin 401 are two pages of selection tables designed to aid in selecting the proper purifier for any steam, air, gas, or vapor installation. Typical examples and solutions show how the tables are used. Operation and advantages of internal downflow purifiers for steam drums, flash tanks, evaporators, pack towers, deodorizers, stills, bubble-cap towers, and receivers are described. Dimensions, weights, and specifications are tabulated. The V. D. Anderson Co.

LUBRICANTS & LUBRICATION EQUIPMENT

215—Lubricating Oil

Excellent time-temperature characteristics and application by any method are advantages listed in technical data sheet 17, for newly developed lubricating oils. Physical properties and advantages are discussed, and a chart shows service life characteristics. Sun Oil Co.

INSTRUMENTS & CONTROLS

216—Control Systems

Discussed in 6-page folder 3010 are control systems for the power industry. To suggest how control systems can be arranged, the bulletin presents views of actual installations and discusses some of the interesting details. Panellit, Inc.

217—Temperature Regulators

Self-operating temperature regulators for steam, liquids, and gases are appraised in 8-page bulletin ST162. Design features and specifications are presented for direct acting and reverse acting types. Engineering data are included in a section describing how to select regulators. Also described are accessories including separable bulb sockets, bulb packing glands, and cast iron strainers. Farris Stacon Corp.

218—Mold Temperature Control

Discussed in 8-page technical bulletin 7 is the problem of maintaining proper temperature control of injection molding equipment. Ten pertinent questions regarding

(Continued on page 94)

LETS EXPANSION KEEP ON THE MOVE

PENFLEX TUBING
ABSORBS THERMAL EXPANSION...PROVIDES FLEXIBILITY

Write for this helpful folder, "Flexineering."

Coal dust showers over equipment, floors and lines were regular occurrences in one large power plant. Thermal expansion moved steel tubes feeding powdered coal to the burners of high pressure steam boilers.

Then Penflex "Flexineering" recommended a flexible steel "overcoat" for the rigid steel feed pipe. Lengths of 20" and 24" I.D. interlocking, galvanized steel tubing were installed. Penflex tubing now forms a flexible seal between the hopper and tube, assuring protected delivery of powdered fuel.

Let Penflex "Flexineering" help you on tubing problems. Penflex manufactures a complete line of four-wall, interlocking and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from $\frac{1}{8}$" I.D. and up . . . automatic barrel fillers, pneumatic rivet passers, accessories and fittings.

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new bulletins

(Continued from page 92)

the importance of injection mold temperature control are answered by experts in the field. Also included is a chart which lists the mold difficulties which occur with various thermoplastics when the temperature is too high or too low. Features of a heating and cooling unit are discussed. Sarco Co., Inc.

MATERIALS OF CONSTRUCTION

219—Nickel Alloys

Helpful technical publications covering the many aspects of nickel alloys, and their applications, are listed in two available bulletins. Each publication, including books, bulletins, and technical papers, is described briefly. Instructions on how to order literature, free of charge, are included. The International Nickel Co., Inc.

MECHANICAL POWER TRANSMISSION

220—Roller Chain Sprockets

Advantages of sprockets using tapered bushings are appraised in 24-page booklet A-624. Data are provided to aid in selection. Riveted and cottered type roller chains also are described. Of particular value is a section discussing selection of roller chain drives. Included are tables of horsepower ratings, tables on the calculation of chain length and center distance, and discussions on the installation, lubrication, cleaning, and maintenance of roller chain drives. Dodge Manufacturing Corp.

221—Fluid Drives

Operating principles for variable speed fluid drives are discussed in 24-page bulletin 9319. Component parts, applications, advantages, dimensions, auxiliaries, and controls are discussed. Included in an engineering section are torque charts and a table on speed reduction factors. Hydraulic Coupling Div., American Blower Corp.

PIPING, TUBING, & HOSE

222—Wrought Iron Pipe

Data contained in 4-page bulletin 27a-By includes information most frequently required by engineers concerned with the design and specification of wrought iron pipe. Suggested applications include special services such as radiant heating and snow melting systems, as well as numerous uses in heating, air conditioning, and water supply systems. Of particular interest is a handy radiant heating conversion chart. Consolidated tables list dimensions, threads per in., mill test pressures, length per sq ft of surface area, length per cu ft of volume, and gal per lineal ft for standard weight and extra strong pipe. The analysis and physical properties of wrought iron also are tabulated. A. M. Byers Co.

223—Prefabricated Conduit System

Introduced in 4-page folder 5210, is a newly developed large diameter, prefabricated conduit system for protection of underground services. Prefabricated to job requirements, it contains piping for steam, condensate, water lines, fire lines, or process purposes all in place and insulated where required. Also included are traps, valves,

(Continued on page 96)

What it takes to make a 3000 Degree Refractory Concrete

Because of the widespread interest in the use of refractory castables, many furnace operators have asked us for the story behind the performance of B&W's unique refractory concrete, Kaocast.

Here are the answers to some of the most frequently asked questions:

Q. *When you refer to Kaocast as a 3000 degree refractory castable, do you mean that its melting point is 3000° F?*

A. No, this means that its service use limit is 3000° F; its melting point is 200 degrees higher.

Q. *Just what does it take to make a 3000 degree refractory castable like B&W Kaocast?*

A. Let's first define a few terms. Refractory castables are made with granular materials which are volume stable at high temperatures and which can undergo repeated heating and cooling cycles without disintegration. These materials, known as refractory calcines or grogs, are blended with suitable hydraulic binders. The initial strength of a refractory castable is thus developed in the same manner as that of ordinary concrete—that is, through the chemical action between water and the binder. A strong *ceramic bond* is formed when the refractory castable is subjected to temperatures above the vitrification point.

Q. *Then you have a grog, a binder and a method of putting them together. Which is most important?*

A. You can't say that any *one* is most important. It's a combination of all three. Let's take them one at a time. Our grog consists primarily of the proper blend of kaolin and other alumina-silica materials. This ratio enables us to achieve a grog with minimum expansion and shrinkage, a high fusion point, and greater stability under load, at varying temperatures.

Q. *And now, what about the binder?*

A. There are a number of factors responsible for the success of the Kaocast binder. One is the compound Tricalcium Penta-aluminate (3 lime to 5 alumina). This formula produces the most refractory compound (highest melting point) that can be made from lime and alumina. Another is that by using the purest commercially available lime and alumina, the Kaocast binder is substantially free of iron and silica. Such traces of these that are present combine during the prefiring of the binder to produce stable compounds.

Q. *Just how important is the manufacturing or "blending" of the grog and the binder?*

A. If one factor could be singled out as "most important" it would be quality control.

Direct control over the fineness of materials, prefiring temperatures, and other phases of manufacture is possible at B&W because both the grog and the binder are made and blended at B&W's Augusta Works—under B&W's direct control and supervision.

Q. *These factors you've discussed must add up to some specific advantages of Kaocast. What are they?*

A. B&W Kaocast has all the advantages of easy installation which are responsible for the widespread interest in refractory concretes, plus these exclusive features: It is the only 3000 degree refractory concrete with high resistance to spalling and low volume change throughout its operating range.

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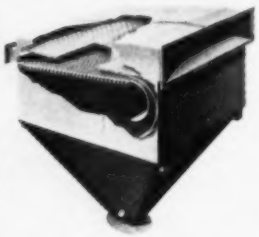

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High efficiency from 100 to 2000 BHP. Traps 99% of all 100-mesh and larger cinder discharge. Is effective on natural draft boilers!

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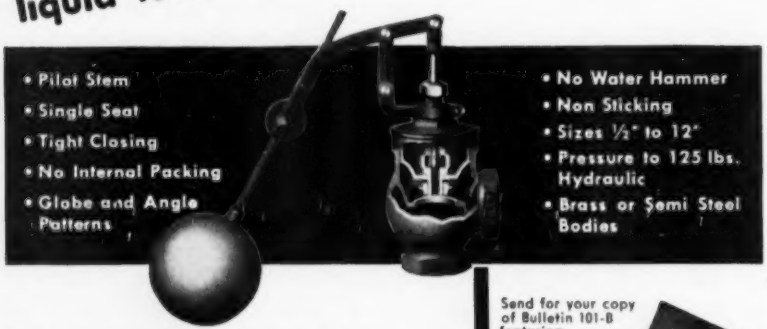

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2509 S. Washtenaw Avenue — Chicago, Illinois

new bulletins

(Continued from page 94)

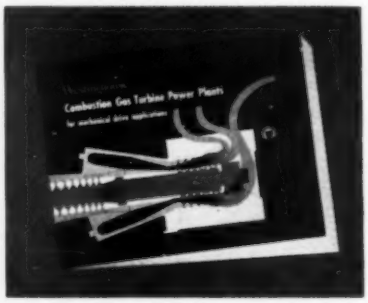
and expansion devices. The literature explains how the system is installed and stresses the simplicity of making joint connections. The Ric-wiL Co.

224—Rubber Hose

"Tips on Hose Care," a 4-page folder, describes the proper procedure in the use and storage of various kinds of hose, including steam, fire, oil, gasoline, water, air, suction, and sandblast types. A list of do's and don'ts are included to simplify installation. Methods of making static bond also are described. Hewitt Rubber Div., Hewitt-Robins, Inc.

225—Flexible Metal Hose

Flexible metal hose developed to isolate vibration in connecting suction and discharge lines to refrigeration and air conditioning machinery, pumps, and turbines, is described in a data sheet. Specifications are listed in tables, and a section of installation instructions classifies the various types of motions. Chicago Metal Hose Div., Flexonics Corp.



ENGINES & TURBINES

226—Gas Turbines

Twelve factors to be considered in selecting a combustion gas turbine power plant for mechanical drive service are listed in 24-page booklet B-5859. Construction and design features, load diagrams, dimensioned outline drawings, and performance curves for four types of turbines are featured. Sample calculations show how to use the curves to determine various engineering data. Also presented are design details of the air compressor rotor and casing, gas turbine rotor and casing, combustion system, auxiliary assembly, control panel, and double helical gears. Westinghouse Electric Corp.

WATER TREATMENT & WASTE DISPOSAL

227—Water Conditioning

Water conditioning for boiler, process, and general applications is discussed in 20-page bulletin 611A. A zeolite unit for manual and automatic operation is featured. In addition, chemical feed, zeolite-post treatment, zeolite-alkalinity neutralization, split-stream, and anion exchange dealkalization systems for boiler, process, and general water conditioning purposes are covered. Data are presented on filters, purifiers, degasitors, zeolites, ion-exchange resins, and water treatments for all purposes. Elgin Softener Corp.

228—Deaerating Heaters

Specific functions and requirements of spray-type deaerating heaters are explained in 8-page bulletin WC-101A. Design features and operation are described, and accessory equipment is outlined. Illustrations include sectional drawings and representative installation photographs of both horizontal and vertical designs, together with flow charts of units in typical applications. Graver Water Conditioning Co.

229—Gravity Filters

Gravity filters are the subject of 24-page booklet 2539A. Concrete, steel, and wood types are discussed. Useful engineering information, including tables of specifications and a nomograph for selecting wash trough dimensions are presented to aid the engineer in planning systems. Controls also are discussed. The Permutit Co.

TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 99. Your requests will be handled promptly.

PUMPS & COMPRESSORS

230—Controlled Volume Pumps

Design features and construction of motor-driven controlled volume pumps are described in 40-page booklet 553. Technical data include capacity-pressure selection tables, types of capacity adjustments, standard and special designs, and packaged systems. A 2-page chart describes typical applications in six major industries. Also included is a 4-page materials selection chart. Milton Roy Co.

231—Vertical Turbine Pump

Inherent characteristics of vertical turbine pumps are briefly described in 12-page bulletin W-450-B41. To point out the diversified applications for this unit, the booklet presents actual case histories of its use in deep wells, to move water from surface sources, for recirculating cooling water, and for condensate return, booster service, and fire prevention. Worthington Corp.

THERMAL INSULATION

232—Industrial Insulations

Fibrous glass insulation products, and hydrous calcium silicate heat insulations, are the subject of an 84-page book. Fibrous glass insulations include pipe, equipment, duct, and low temperature types, and heat insulations contain products for use at temperatures from below zero to 1200 F. Descriptions of the products include properties, uses, forms and sizes, coverings and accessories, engineering data, application specifications, and ordering information. Owens-Corning Fiberglas Corp.

VALVES & REGULATORS

233—Welded Floats

Welded floats of stainless steel, monel, and chrome plated steel in spherical, elliptical, and cylinderical shapes are presented in 8-page bulletin 753. Sizes from 2 to 14 in. diam for pressures from vacuum to 4800 psi are listed. Application and construction data are presented. Weights, buoyancies, and collapsing pressures are tabulated. W. H. Nicholson & Co.

—End

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These EVERLASTING Duplex Boiler Blow-Off Units are assuring double safety in plants all over the country.

In the unit illustrated above, the left-hand valve is the standard quick-operating EVERLASTING design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use. The right-hand valve is an EVERLASTING Angle Valve, stoutly built to withstand shocks and abrasion of blow-down solids.

Below are shown two additional EVERLASTING Duplex Units, each including the EVERLASTING "Y" Valve . . . simple and sturdy in design, with all parts interchangeable with those of the Angle Valve.

All EVERLASTING boiler blow-off designs conform with ASME codes, and are available in a range of sizes for pressures up to 600 psig.

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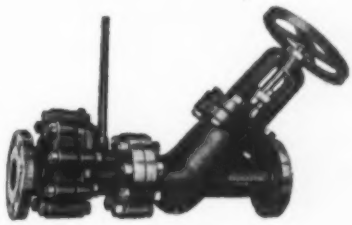

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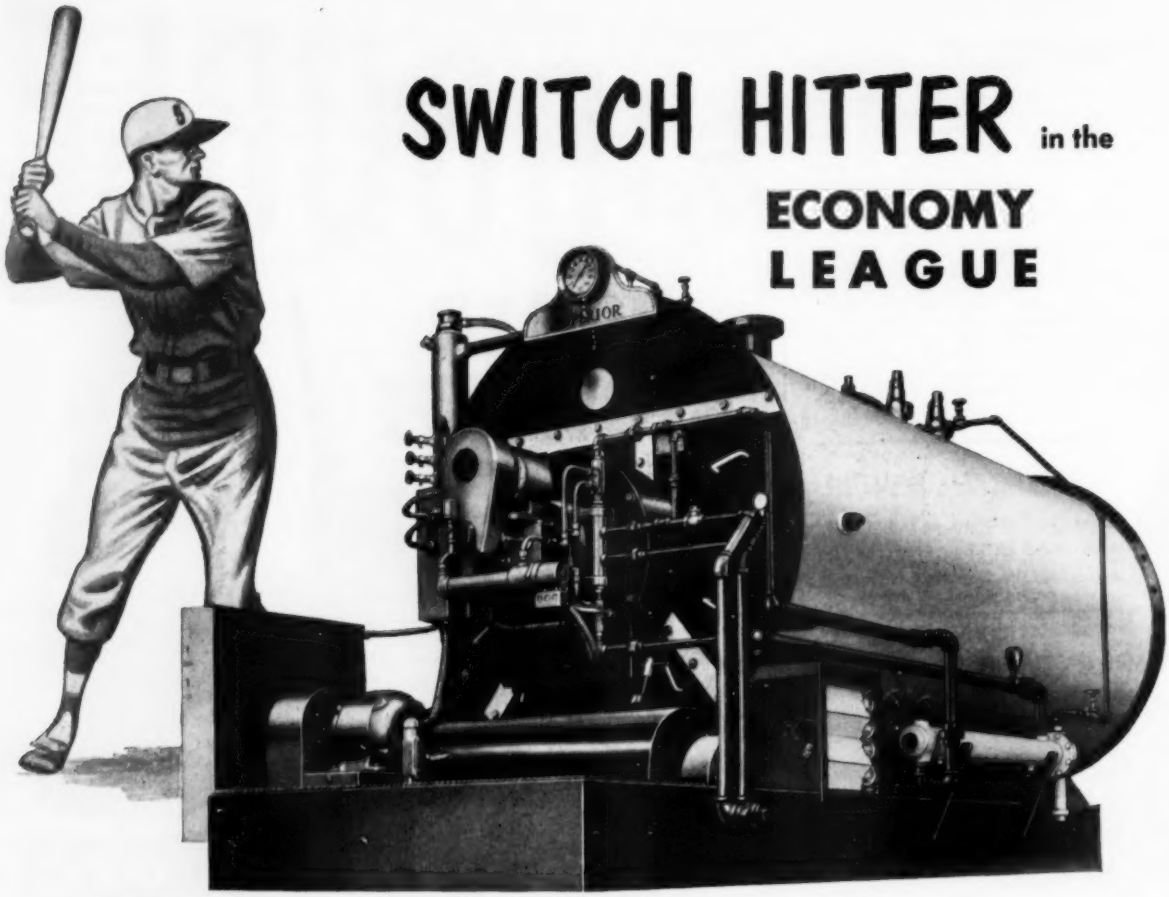

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readers' guide

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AIR FILTERS & DUST COLLECTORS

Key No. 500—'LR' bulletin contains data on the Buell 'LR' fly ash collector for small boilers. Buell Engineering Co. p 96.

BOILERS & BOILER ACCESSORIES

Key No. 501—Booklet available giving information on Taylor stokers. American Engineering Co. p 84.

Adv. p 33 contains information on Heacon dampers designed to meet practically any pressure or temperature specifications. The Thermix Corp.

Key No. 502—Bull BW 40 contains valuable data on modern baffle-wall constructions. The Engineer Co. p 110

Descriptive literature available on Wickes steam generators. The Wickes Boiler Co. p 125.

Key No. 503—Bulletin contains data on Vogt two drum steam generators. Henry Vogt Machine Co. p 109.

Key No. 504—Catalog 502-F contains complete details on Superior steam generators. Superior Combustion Industries, Inc. p 98.

Adv. p 114 contains information on coals. General Coal Co.

Key No. 505—Bull Ec-52B describes Econotherm packaged boilers. Dutton Boiler Div., Hapman-Dutton Co. p 35.

Key No. 506—Coupon on p 41 offers Petro catalog of commercial-industrial oil and gas-oil firing equipment. Petro Division.

Adv. p 42 contains information on Leffel Scotch boilers. The James Leffel & Co.

Details available on Henszey feedwater meters. Henszey Co. p 102.

Kewanee steel boilers are described on p 112. Kewanee-Ross Corp.

Key No. 507—Catalog describes Truscale gages for positive distance reading of liquid levels. Jerguson Gage & Valve Co. p 121.

FW package steam generators are described on p 91. Foster Wheeler Corp.

Key No. 508—Bull VP-132 contains data on C-E Type VP package boilers. Combustion Engineering, Inc. p 25.

See adv. p 85 for information on bituminous coal. Bituminous Coal Institute.

Adv. pp 14, 15 contains information on Riley traveling grate spreader stokers. Riley Stoker Corp.

Key No. 509—Bull 2000 contains complete details on Preferred's unit steam generator. Preferred Utilities Mfg. Corp. p 32.

BUILDING MATERIALS & MAINTENANCE

Key No. 510—Free handbook on commutator and slip ring maintenance offered in coupon on p 102. Ideal Industries, Inc.

Adv. p 119 contains data on electroforged steel grating. Blaw-Knox Equip. Div., Blaw-Knox Co.

Key No. 511—Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. p 118.

DIESELS & GAS ENGINES

Adv. p 9 contains information on the LS-8 diesel by The Cooper-Bessemer Corp.

ELECTRICAL EQUIPMENT

Adv. p 10, 11 contains information on I-T-E unit substations for modern plant distribution. I-T-E Circuit Breaker Co.

Adv. p 92 contains information on the Murray turbo-generator. Murray Iron Works Co.

Key No. 512—Bull 5810 gives full data on G.E.'s weather-protected motors. General Electric Co. p 44.

Key No. 513—U. S. totally-enclosed explosion-proof motors are described in available bulletin. U. S. Electrical Motors, Inc. p 118.

New G-E White rigid steel conduit is described on p 26, 27. General Electric Co., Construction Materials Div.

Key No. 514—See adv. p 37 for listing of data sheets offered on applications of Chromalox radiant heat. Edwin L. Wiegand Co.

(Continued on page 104)

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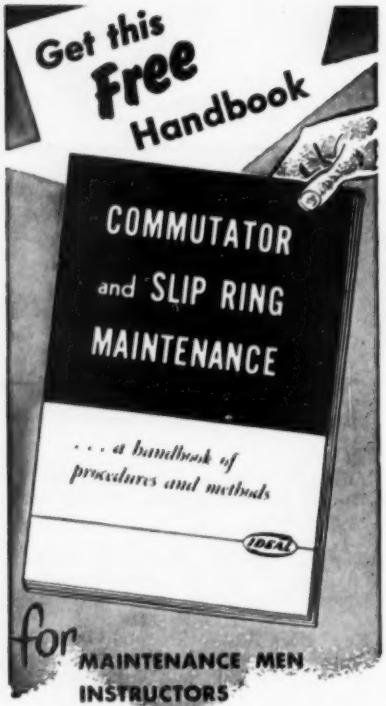
NOTE—This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly —or list paragraph key numbers on reader service card (page 99) to get data you want



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THE methods and procedures described were developed by recognized, practicing maintenance authorities. They have been proven by conclusive evidence over many years in hundreds of operations. A concise guide, this 39-page handbook tells the practical operating man everything he needs to know about:

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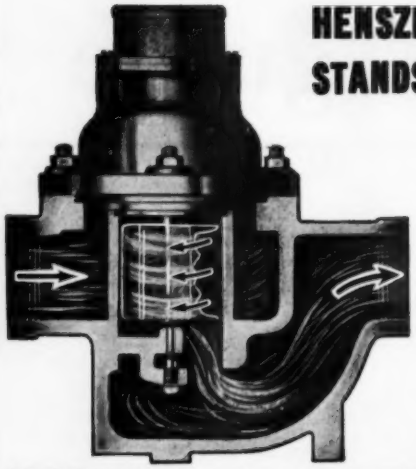
City_____ Zone____ State_____



HENSZEY *Feed Water* METER STANDS UP *where others* FAIL

The cutting, abrasive action of hot, dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. Henszey Meters stay accurate—stay on the job—accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-Running Chemicals and other "hard-to-measure" liquids. For details consult Sweet's Catalog or write:

HENSZEY CO., Dept. A-8, WATERTOWN, WISCONSIN

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Boiler Feed Regulators • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

W. S. ROCKWELL VALVES

Engineered for Dependable Service on Air, Gases, Liquids, Semi-Solids

FULL FLOW with minimum pressure drop.

ANY CONDITIONS of commercial, drip- or bubble-tight closure, with quick, positive control and shut-off manually or automatically.

RESISTANT Made ruggedly for all conditions of corrosion, erosion, temperatures to 2000° F., pressures to 300 p.s.i.

ALL TYPES Butterfly, wafer or slide valves, 1" to 120" pipe size.

W. S. ROCKWELL COMPANY
ROCKWELL SINCE 1888 BUILT
BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES
2303 ELIOT STREET • FAIRFIELD, CONN.
Sales Representatives in Principal Cities

When competition gets tough—when buyers compare *quality* as well as price—"Hyatt-equipped" is a recognized guide to top value! That's because business men know that *Hyatt* bearings are *better* bearings—performance-proved to last longer at peak efficiency! And they know also that Hyatt bearings are a reliable indication of *extra quality, longer life,* and *lower maintenance costs* in any product they buy or sell! For cylindrical or spherical roller bearings, HYATT is the name to remember! *"If it's built with Hyatts, it's built to be the best!"*
Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

AIRETOOL makes tube expansion —easy

Airetool expansion control and Airetool expanders are the unbeatable combination for rapid, uniform tube expansion!

Precision-made ball-bearing expanders are designed by Airetool for every type of heat exchanger and condenser tube to 2½ in. ID.

Airetool's ball-bearing thrust collar eliminates frictional heat and their tapered mandrel and roll design prevent sharp off-set inside the tubes.

With Airetool's all-electric expander control, even the most inexperienced operator can roll uniform, tight tube joints in half the time . . . and without danger of damage to the tube sheet.

No delicate parts to go out of order . . . no costly maintenance problem with the Airetool electric control . . . set the dial for the tube and metal being expanded . . . the control does the rest.

AIRETOOL MANUFACTURING COMPANY

SPRINGFIELD, OHIO

Literature upon request. Write to The Airetool Mfg. Co., 318 S. Center St., Springfield, Ohio.

BRANCH OFFICES: Philadelphia, New York, Houston, Chicago, Baton Rouge, Hudson Heights (N.J.)

There's an AIRETOOL tube cleaner and tube expander for every type of tubular construction.

Representatives in principal cities in U.S.A., Canada, Mexico, South America, England.

readers' guide

(Continued from page 101)

ENGINES & TURBINES

Key No. 515—Bull S-146 contains information on Terry multistage turbines. The Terry Steam Turbine Co. p 117.

FANS & BLOWERS

Key No. 516—Catalog B-10 contains complete details on new line of Hartzell centrifugal blowers. Hartzell Propeller Fan Co. p 2.

FILTERS, STRAINERS, & PURIFIERS

Key No. 517—Bull 1226 contains complete information on Sarco scraper strainers. Sarco Co., Inc. p 115.

Key No. 518—Coupon on p 89 offers information on Cuno Auto-Klean strainers. Cuno Engineering Corp.

Key No. 519—Bull 184 contains data on Armstrong strainers for steam, air, gas, water and oil lines. Armstrong Machine Works. p 124.

HEAT EXCHANGER EQUIPMENT

Key No. 520—Catalog No. 5 gives information on **p-k** hot water heaters. Patterson-Kelley Co., Inc. p 46.

Elliott Type F surface condensers is described on p 47. Elliott Co., Condenser Dept.

HEATING, AIR CONDITIONING, & REFRIGERATION

Key No. 521—Catalogs CUH-846-A & BC-1049 contain complete data on Grid unit heaters and blast coils. D. J. Murray Mfg. Co. p 119.

Adv. p 105 contains full information on Trane gas-fired unit heaters. The Trane Co.

INSTRUMENTS & CONTROLS

Key No. 522—Data File 5C-83 contains full story on many ways the Model F-3 analyzer and sampling system can benefit your operations. Arnold O. Beckman Inc. p 107.

Key No. 523—Details available on Liquidometer tank gage. The Liquidometer Corp. p 106.

Key No. 524—Bull 52-1075-223 contains full information on Hays Miniscale gages for indicating pressures of fluids. Hays Corp. p 43.

Information available on the complete line of Weston instruments. Weston Electrical Instrument Corp. p 94.

Key No. 525—Bull GEC-979 contains further details on G-E's new portable

(Continued on page 108)

This Test Shows Why

Trane Gas-Fired Unit Heaters give you

Maximum Heat Per Fuel Dollar!

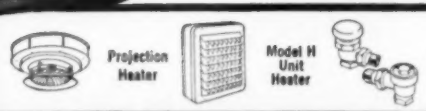
Hold your hand beside a flame. You can hardly feel the warmth! The heat rises rapidly in a narrow column—not toward your hand, *but straight up!* It escapes without heating your hand.

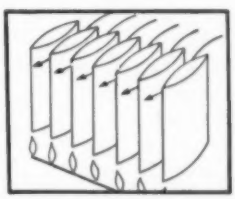
Now put your hand directly over the flame. You get the *full force* of practically all the heat generated by the flame. It hits your hand squarely—mushrooms out over the entire surface.

The NEW TRANE Gas Unit Heater

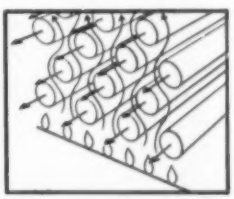
A.G.A. APPROVED—This great new heater, when tested by the American Gas Association against a long list of construction requirements, not only met the specifications—but surpassed them. It combines *increased output* with *unequaled strength* and *outstanding styling*. It gives you maximum heat transfer, maximum service, maximum efficiency.

EXCLUSIVE HEAT DIFFUSION—The patented TRANE Louver Fin Diffuser available with these units gives you complete command of air direction. Funnel it into a concentrated stream. Split it. Or spread it evenly over a wide area.





Conventional gas heaters have *vertical* chimney-like tubes. Heat rushes through in quick escape. Contact of heat with inside surface is brief. Heat escapes out the top. Room air is blown past the outside surface of the tubes. You can see why this can be so inefficient.



The new TRANE unit has *horizontal* "boiler tube" construction. Heat strikes tubes squarely—mushrooms around them, rises to the row above. Each tube is *bathed* in heat. Air to be heated is forced through tube's oven-like interior. Result: maximum B.T.U's per fuel dollar.

TRANE

GAS-FIRED UNIT HEATERS

Cut fuel costs . . . put heat where it's needed

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING AND VENTILATING EQUIPMENT

The Trane Co., La Crosse, Wis. • Eastern Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U. S. and 14 Canadian Offices

NOT THIS...

Now...for a good shower

—deep freeze!

—scalding hot!

BANISH "BOOBY TRAP" SHOWERS

Use POWERS THERMOSTATIC Water Mixers

BUT THIS

Real comfort and safety. No waste of time or hot and cold water.

POWERS THERMOSTATIC WATER MIXERS

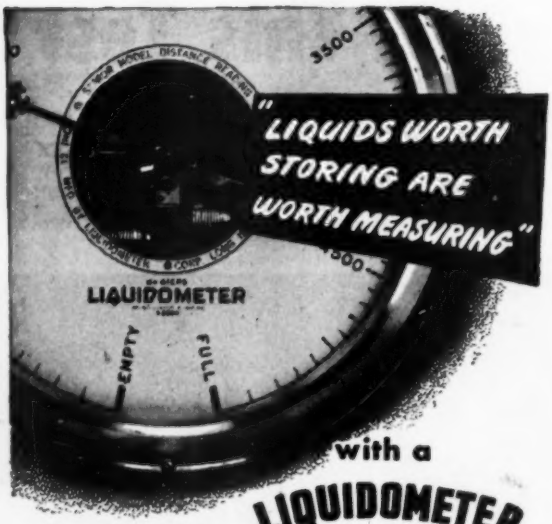
—eliminate shower accidents

They are completely automatic, hold shower temperature wherever you want it regardless of pressure or temperature changes in water supply lines. Failure of cold water instantly shuts off the shower.

Tests prove Powers is safest shower regulator made for factories, schools, hospitals, hotels and clubs. Thousands now in use.

Used for Many Industrial Processes. Users report control within ½° F. Temperature Ranges: 65-115° F., 60-125° F., 75-175° F. Write for Bulletin 365. (b13)

THE POWERS REGULATOR CO.
Skokie, Ill. • Offices in Over 50 Cities • Est. 1891

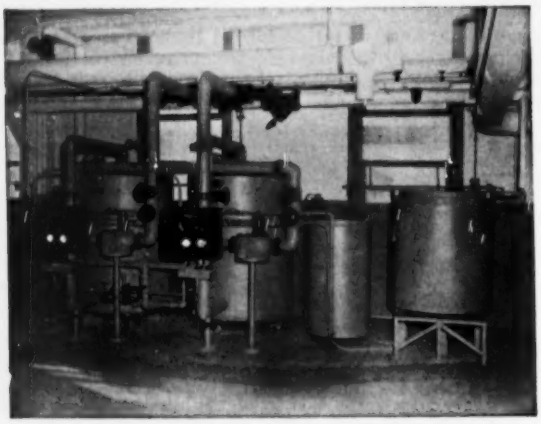


with a LIQUIDOMETER Tank Gauge

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.



FULLY AUTOMATIC INVERSAND WATER SOFTENING PLANT

The above is one of our many hundreds of Water Conditioning Plants automatically operated by our H & T poppet type multiport valves.

Whether your water problem is softening, filtration, alkalinity reduction, oil removal, or demineralization, requiring new units or modernizing old, we invite your inquiries.

Single or Multiple Units — Manual, Semi-Automatic or Fully Automatic — We can serve you.

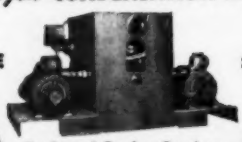
OVER 50 YEARS EXPERIENCE
Write for FREE Bulletin

HUNGERFORD & TERRY, INC.
CLAYTON 1, NEW JERSEY

APCO Packaged CONDENSATION RETURN UNITS

for the SMALL LOW PRESSURE JOBS

10 to 40 lbs. with 8, 15, 30 Gallon Receivers



Packaged Duplex Condensation Return Unit with No. 4 Series Apco Pumps.

Start saving valuable heat units with APCO Square Tank Units. Built to meet demand for a smaller unit with the superb performance of our larger units. Remember, the Pumps are Apcos. No Vapor Binding — Special Provision for Expansion and Contraction — No Frictional Wear within pump. Thus, ECONOMY.

Write for Bulletin 113-ST

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS
AURORA PUMP COMPANY

Subsidiary of the New York Air Brake Company
42 Loucks Street, Aurora, Illinois

Start these savings NOW...

with the

Arnold O. Beckman

MODEL F-3

OXYGEN ANALYZER

Typical Arnold O. Beckman installation in a major municipal utility

Save Fuel!

Buying fuel that goes up the stack unburned is buying lost efficiency and objectionable smoke. Insure *complete* combustion with a Model F-3!

Save Heat!

Excess air only wastes valuable heat. You *know* when to cut down on excess air with a Model F-3!

Save Upkeep!

Costs for operating and maintaining the Arnold O. Beckman Analyzer are negligible. Only periodic checking is required, and no special skill is needed to operate the F-3.

Get the full story on the many ways the Model F-3 Analyzer and Sampling System can benefit your operations. Write for Data File 10-03

Features of the Beckman Model F-3

SELECTIVITY Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

MANY RANGES Combustion ranges include 0-5%, 0-10%, 0-15%, and are provided with a second range of 0-25%. Other ranges up to 0-100% O_2 are available. Calibration of the Model F-3 is strictly linear and scale is accurate over the entire range.

HIGH ACCURACY ±1% of full scale for spans of 5% and greater. Accuracies within .05% O_2 on 0-5% range are available.

AIR CHECK Simple positive check of proper operation by recording the air point on the second range.

SIMPLE SAMPLING Independent of flow rate. Nothing is added to the sample. The sample may be dry or saturated. Corrosive gases will not poison the instrument. Only a small sample (3-15 cu. in./min.) is required.

LOW MAINTENANCE Completely insulated against extreme shock and vibration. No chemicals, no catalysts to replenish. No wicks, filaments, orifices, valves, etc., to clean and replace.

STANDARD RECORDERS Any standard industrial potentiometer recorder or pneumatic receiver can be used.

Arnold O. Beckman INC

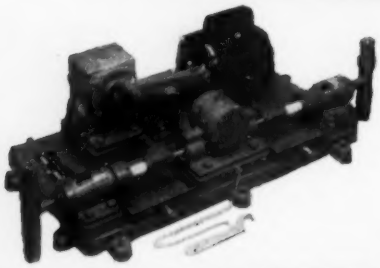
Manufacturers of Industrial and Scientific Instruments

1020 MISSION STREET

SOUTH PASADENA, CALIFORNIA

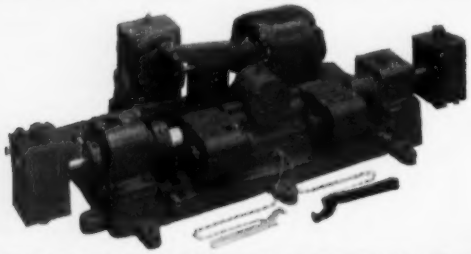
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



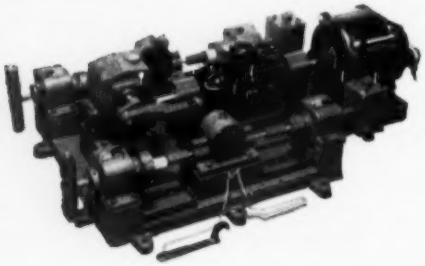
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



VARIABLE SPEED UNITS

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

Write for Catalog:

Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2355 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

readers' guide

(Continued from page 104)

testing instrument. General Electric Co. pp 20, 21.

LUBRICANTS & LUBRICATION EQUIPMENT

Key No. 526—Bulletin 550 and free testing sample of Non-Fluid Oil. New York & New Jersey Lubricant Co. p 121.

Key No. 527—Literature describes complete line of Hilco purifiers, filters, reclaimers and conditioners. The Hilliard Corp. p 6.

Key No. 528—Technical bulletins available on new lubricant, Solnus oil. Sun Oil Co. p 83.

Rubilene oil for diesel lubrication is described in adv. p 39. Sinclair Refining Co.

Adv. p 49 describes Standard HD oil. Standard Oil Co. (Indiana).

Key No. 529—Further information available on Manzel force feed lubricators and chemical feeders. Manzel, Inc. p 114.

MATERIALS OF CONSTRUCTION

Adv. p 40 contains information on "S" Monel. The International Nickel Co., Inc.

MATERIALS HANDLING EQUIPMENT

Key No. 530—Car shakers and rotary dumpers are described in Books 2345 & 2048-A. Link-Belt Co. p 4.

Key No. 531—Bull 300 contains data on G-W basic designs of coal handling. Gifford-Wood Co. p 113.

MECHANICAL POWER TRANSMISSION

Information on Hyatt roller bearings is given on p 103. Hyatt Bearings Div., General Motors Corp.

Consult the Goodyear Technical Man for your needs in conveyor belts and other industrial rubber products. Goodyear Tire & Rubber Co. p 3.

Available literature describes solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. p 115.

Adv. p 48 contains data on Gates Vulco ropes. The Gates Rubber Co.

Key No. 532—Catalog and handy selector charts available on Lovejoy flexible couplings. Lovejoy Flexible Coupling Co. p 121.

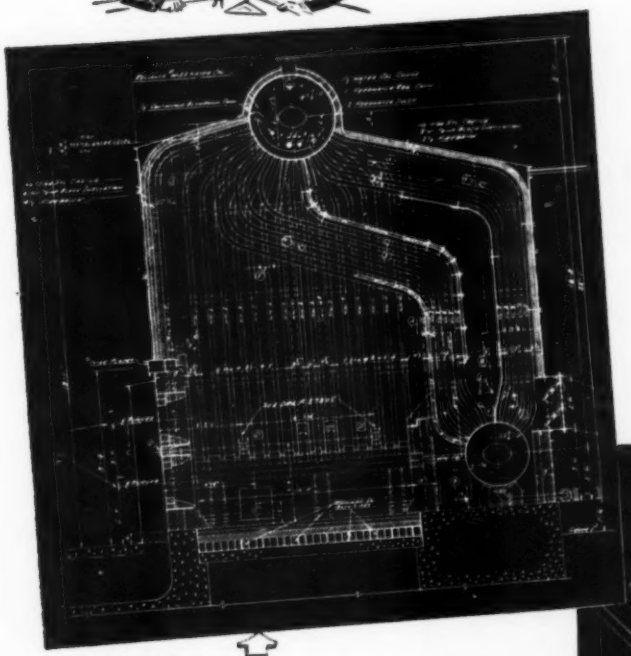
PACKINGS AND GASKETS

Key No. 533—Bulls 4502 and 4401 con-

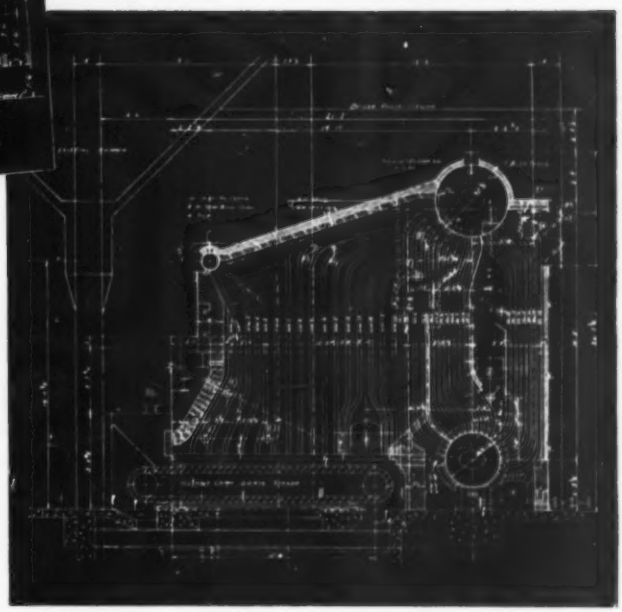
(Continued on page 110)

Industry Approved

Two-Drum STEAM GENERATORS by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS

DISTILLERIES • HOTELS

HOSPITALS • CHEMICAL PLANTS

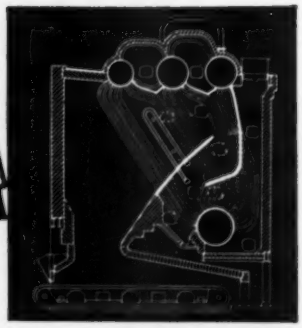
PETROLEUM REFINERIES

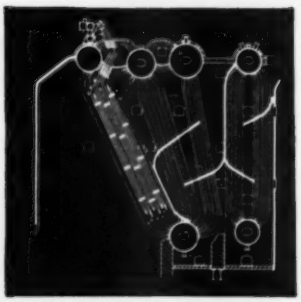
HENRY VOGT MACHINE CO., Louisville 10, Kentucky

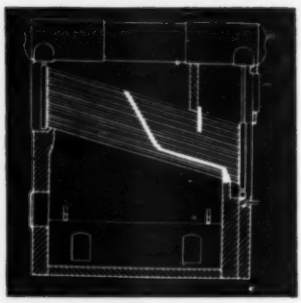
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

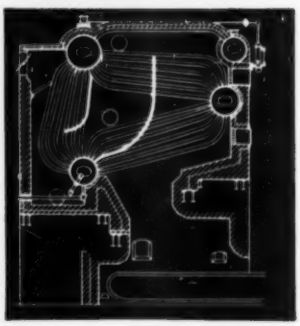
MORE STEAM

Procurable with Improved Baffles









Demands for greater boiler output are often met by installing more efficient baffles.

Overload operation need not be destructive nor cause serious outages due to furnace failures when the heat path through the boiler is well designed.

Enco baffling boosts steam output safely. The cross flow puts every foot of heating surface to work. The streamlining prevents eddy currents and dead gas pockets.

Enco baffles also cut down draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are used more effectively and less often. They can be applied to any water-tube boiler.

Each application is individually designed by men with 25 years experience in this highly specialized branch of engineering. Installations are made by skilled mechanics.

● ***A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.***

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

readers' guide

(Continued from page 108)

tain data on Pumcups for air and hydraulic mechanisms and for reciprocating pumps. Darling Valve & Mfg. Co. p 24.

PIPE, TUBING, & HOSE

Key No. 534—Free sample of Key-Tite water proof pipe joint compound. Key Co. p 119.

Key No. 535—Bulletin, "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment." A. M. Byers Co. p 23.

Key No. 536—Folder "Flexineering" contains details on Penflex flexible tubing. Pennsylvania Flexible Metallic Tubing Co., Inc. p 93.

Adv. p 122 contains information on Dart unions. Dart Union Co.

Rubber expansion joints adaptable to any pipeline installation for transporting liquids or gases are described on p 124. La Favorite Mfg. Co.

Key No. 537—Cat 130 gives full information on all CMH flexible metal hose. Chicago Metal Hose Div., Flexonics Corp. p 38.

PUMPS AND COMPRESSORS

Adv. p 88 contains information on Weinman pumps. The Weinman Pump Mfg. Co.

Key No. 538—Descriptive literature available on Orchem Little Giant pumps for water softening, boiler treatment and chemical applications. Orchem Pump Div. p 124.

Adv. p 17 contains information on Worthington centrifugal pumps. Worthington Corporation, Centrifugal Pump Div.

Key No. 539—Bull 113-ST describes packaged condensation return units with No. 4 series Apco pumps. Aurora Pump Co. p 106.

Adv. p 36 contains information on Worthington vertical turbine pumps. Worthington Corp., Vertical Turbine Pump Div.

Key No. 540—Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" type pumps. Hills-McCanna Co. p 108.

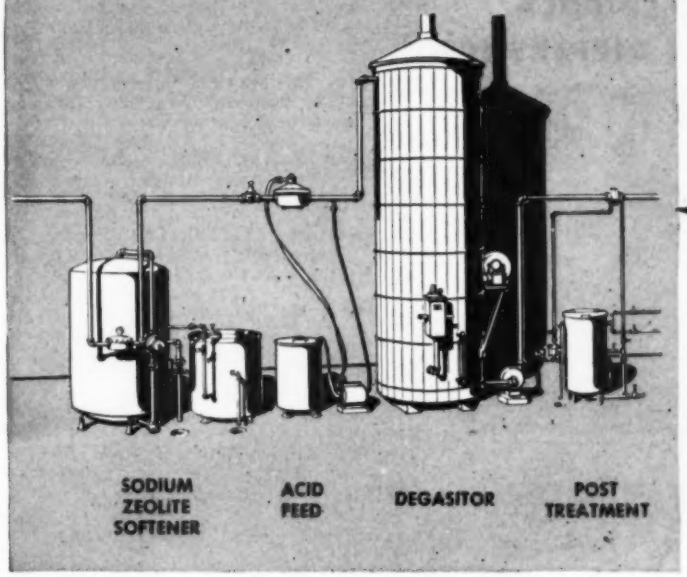
REFRACTORIES

Literature available on R & I Moldit refractory cements. Refractory & Insulation Corp. p 34.

See adv. p 95 for information on 3000° refractory concrete. The Babcock & Wilcox Co., Refractories Div.

(Continued on page 112)

Zeolite-Alkalinity Neutralization Water Conditioning System



Selected by Leonard

Leonard Construction Company
—consultants and builders

...for these six projects

- Swift & Company, Agricola, Fla.
- Swift & Company, Calumet City, Ill.
- Armour & Company, Bartow, Fla.
- Smith & Douglas, Streator, Ill.
- Davison Chemical Corp., Bartow, Fla.
- International Minerals & Chemical Corp., Mason City, Iowa

Delivers Soft Water of low Controlled-Alkalinity and free from CO_2

Leonard Construction Company, well known consultants and builders, is one more in a long list of leading firms that are selecting Elgin Water Conditioning for the exacting requirements of projects such as those listed above. The system graphically illustrated is but one of our many water conditioning systems. It consists of a sodium zeolite water softener followed by acid feed and degasification. Here is the economical answer where soft water of low controlled-alkalinity and free from CO_2 is required. Costly destruction of return lines and equipment resulting from corrosion is prevented.

When heat recovery or blowdown savings will not justify the expense of split-stream dealkalization or deionizing equipment, this system has proven a reliable and highly effective means of overcoming the problem of corrosion in return condensate lines. Being low in investment cost, simple to operate, and requiring but little space, this system is widely used. It will pay you to investigate its many advantages.

A Complete Line To Meet Your Specific Requirements

Whether a simple chemical feed system, a zeolite water softener, one of the many ion-exchange combinations, silica and CO_2 removal, or deionization for the highest quality water known today—you may be sure Elgin can provide the type of system required to produce water of the exact characteristics you need.

Ask for details or let us put our nearest representative in touch with you—Representatives in Principal Cities

THIS CHART TELLS THE STORY

A typical case study—from Armour & Company, Bartow, Fla.

WATER CONSTITUENTS	RAW WATER G.P.G.*	TREATED WATER G.P.G.*
Carbonate Alkalinity	9.00	1.57
Sulfate	0.78	8.21
Chlorides	0.70	0.70
Calcium	5.00	0.00
Magnesium	3.58	0.00
Sodium	1.90	10.48
Potential CO_2	137 ppm	<5 ppm
Dissolved Solids	10.48	10.48
Alkalinity Reduction		82.5%

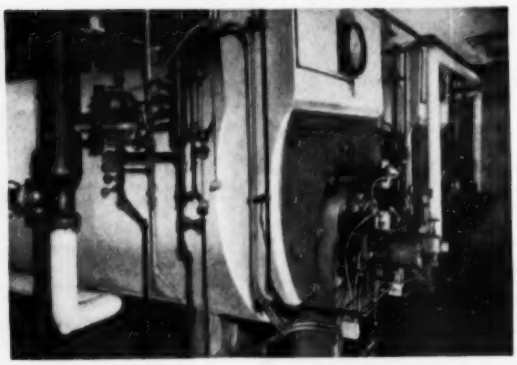
*Ca CO_3 Equivalents

Why Not Obtain Comparable Improvement In Your Boiler and Process Water?

ELGIN
SINCE 1908
WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION • 138 North Grove Avenue, Elgin, Illinois
In Canada: G. F. Sterne & Sons, Ltd., Brantford, Ontario

MORE ENGINEERING
MORE MATERIAL
MORE EXPERIENCE
MAKE THE DIFFERENCE



KEWANEE
STEEL BOILERS

Wherever Heat or Power or Industrial Process Steam is required there is a Kewanee Boiler just right for the job. And into every Kewanee goes *more of everything* that adds to a boiler's life and makes it most economical. Owners expect *more* from Kewanee Boilers . . . and they get *more*.

Pictured is a battery of two Kewanee Scotch-type Boilers, for low pressure in the boiler room of the Men's Dormitory, Bradley University . . . a Kewanee series which "stands on its own legs," needing no special setting and requiring comparatively little floor space or head room.

Men's Dormitory
BRADLEY UNIVERSITY
Peoria, Illinois
GREGG-BRIGGS & FOLEY
Architects
ASSOCIATED ENGINEERS
Construction Engineers
2 Kewanee Scotch Boilers installed by
PEORIA PIPING & EQUIPMENT CORP.

KEWANEE-ROSS CORPORATION
Division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS

Serving home and industry

readers' guide

(Continued from page 110)

STEAM SPECIALTIES

Key No. 541—Bull 35 contains data on Illinois steam traps. Illinois Engineering Co. p 118.

Key No. 542—Full information available on Hoffman bucket traps. Hoffman Specialty Co. p 30.

Key No. 543—Bull T-1740 contains data on Yarway Impulse steam traps. Yarnall-Waring Co. p 50.

Key No. 544—Cat 68-Q describes Strong 70 Series traps. Strong, Carlisle & Hammond Co. p 116.

Key No. 545—Free book "Solving Steam Trap Problems" gives complete story on Super-Silvertop traps. The V. D. Anderson Co. p 126.

TOOLS

Key No. 546—Industrial Roll-Cab that "rolls the shop to the job" is described in the industrial and general catalog of 4000 tools for production and maintenance. Snap-On Tools Corp. p 123.

Key No. 547—Bulletin Y-29 describes Lagonda tube cleaners. Elliott Co., Lagonda Div. p 22.

Key No. 548—Bull 47A contains information on Wilson tube cleaners and expanders. Thomas C. Wilson, Inc. p 115.

Literature available on Airetool's all-electric tube expansion control. Airetool Mfg. Co. p 104.

VALVES & REGULATORS

Key No. 549—Bulletin describes Everlasting valves with duplex blow-off units. Everlasting Valves. p 97.

Key No. 550—Chapman "Check Book" describes complete line of tilting disc check valves. The Chapman Valve Mfg. Co. p 87.

Key No. 551—Full details on Spence temperature regulator are given in Bull T50. Spence Engineering Co., Inc. p 31.

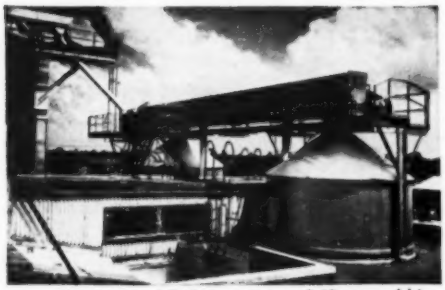
Key No. 552—Bull 101-B contains data on the complete line of Davis float valves. Davis Regulator Co. p 96.

Key No. 553—Bulls B-425 and B-433 contain information on Yarway blow-off valves. Yarnall-Waring Co. p 18, 19.

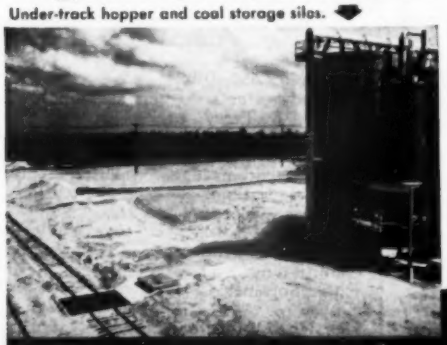
Key No. 554—Bull 365 contains data on Powers shower regulators. The Powers Regulator Co. p 106.

Adv. p 102 contains information on all types of Rockwell valves with manual or automatic control. W. S. Rockwell Co.

(Continued on page 114)

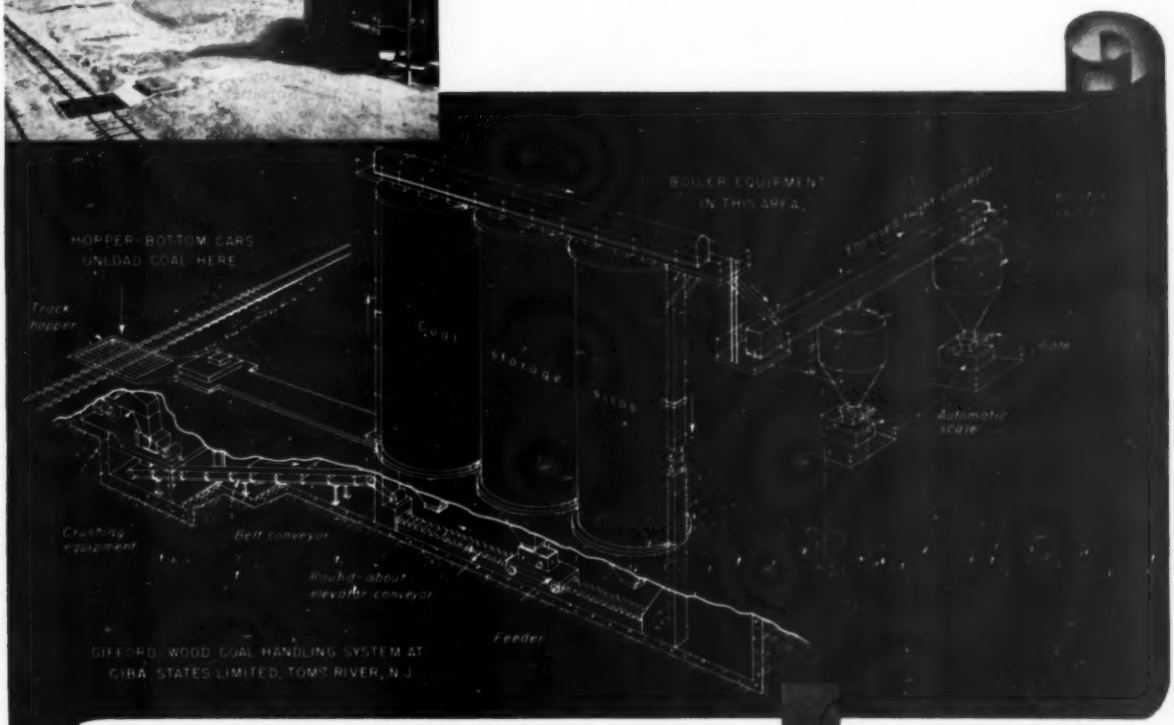


Enclosed flight conveyor and 60-ton coal bin.
Under-track hopper and coal storage silos.



ANOTHER G-W AUTOMATIC COAL HANDLING SYSTEM...

this time for Ciba States Ltd.



Now nearing completion at Toms River, N. J., is the world's most modern vat-color producing plant—and helping insure maximum power development with top economy will be the most efficient coal handling system, by Gifford-Wood. The system was designed and built by G-W engineers for Ciba States Limited, and includes unloading, storage, and feeding facilities.

For more than 140 years, G-W has met and solved materials-handling problems. This experience, coupled with planned application of the most modern equipment, is at your disposal. This project is only one example of complete design, construction, and erection under one responsibility

For details on this, or other Gifford-Wood coal handling installations, please write for Bulletin No. 300.

As diagrammed, coal passes from hopper cars through crushers, and then by means of belt and bucket conveyors, to silo storage. Transfer of coal from storage silos is by gravity feed into a movable car from which the bucket elevator lifts it, by-passing the storage silos, to an enclosed flight conveyor discharging into bins, which feed through coal scales to pulverizers.

GIFFORD-WOOD CO.

Since 1814
Hudson, New York

New York 17
420 Lexington Avenue

St. Louis 1
Railway Exchange Building

Chicago 6
565 West Washington Street

8756

When You Think of Materials Handling—Think of Gifford-Wood

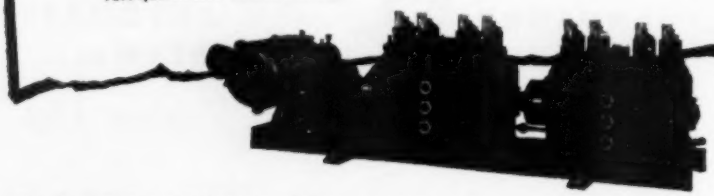
How to cure "FLUID-FEEDOSIS"*

A CASE HISTORY

PROBLEM: Chemical Companies needed really dependable equipment for high pressure lubrication of compressor cylinders and bearings.

SOLUTION: Manzel developed a completely new line of heavy duty Force Feed Lubricators that pump S. A. E. 40 oil at pressures up to 30,000 PSIG. Enthusiastic reports of performance are being received from users.

*Difficulties in pumping chemicals, oils, and other fluids in accurate quantities for lubrication, chemical treating, or other purposes.



For the solution to lubrication difficulties, or chemical feeding problems, more and more companies are turning to Manzel. For 50 years a leader in the field, Manzel is today a flexible, fast-moving organization with the special technical skill for meeting *your* needs quickly and economically. Write for further information about Manzel Force Feed Lubricators and Chemical Feeders.

Safeguard high priced machinery with MANZEL FORCE FEED LUBRICATION
- Reduce Wear
- Prevent Breakdown
- Slash oil consumption
- Insure Round-the-Clock Operation

Manzel

320 BABCOCK ST.
BUFFALO 10, N. Y.

A DIVISION OF FRONTIER INDUSTRIES, INC.

readers' guide

(Continued from page 112)

Key No. 555—Catalog describes reduction of repairs with Sims pump valves. Sims Pump Valve Co., Inc. p 118.

Adv. p 7 contains information on Crane valves. Crane Co.

WATER TREATMENT & WASTE DISPOSAL

Key No. 556—Bulletin describes Inversand water softening system. Hungerford & Terry, Inc. p 106.

Key No. 557—Free copy "This is Nalco" contains data on how to solve water treating problems. National Aluminate Corp. p 13.

Details are available on Elgin water conditioning systems for every need. Elgin Softener Corp. p 111.

Key No. 558—Information available on dealkalization with Amberlite IR-20 and bi-monthly reports on Amber-Hi-Lites. Rohm & Haas Co. p 45.

Key No. 559—Bull 5002 describes removal of scale—Bull 5013 the control of return line corrosion. Other bulletins on water treatment offered in coupon p 28, 29. Dearborn Chemical Co.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

GLENDROCK — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

GENERAL — REG. U.S. PAT. OFF.

ANTHRACITE

Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

General Coal Company

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42 STOCK SIZES

HALLOWELL

SOLID STEEL COLLARS

Your HALLOWELL industrial distributor stocks these precision machined steel collars in sizes to fit shafts from 3/16" to 3" diameter inclusive. The famous self-locking UNBRAKO Socket Set Screw—the screw that won't work loose—assures positive positioning of every HALLOWELL collar. Write for literature. SPS, Jenkintown 39, Pa.

Our Fiftieth Year : A START FOR THE FUTURE

HALLOWELL POWER TRANSMISSION DIVISION

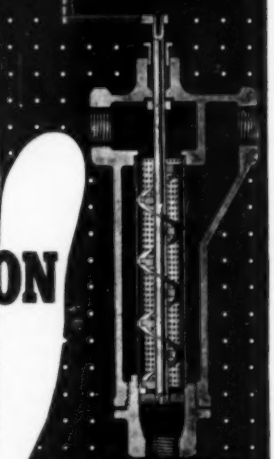
SPS

JENKINTOWN PENNSYLVANIA

DON'T STOP PRODUCTION

Unless strainer screens are frequently cleaned, they eventually clog. The production time lost by the shutdown to clean the choked screen, and the labor involved, can be saved by installing

SARCO SCRAPER STRAINERS



SARCO TYPE VRS SCRAPER STRAINER

Cleaning the screens is easy—just turn the handle! Continuous operation is assured. No messy basket to be lifted out—No exposure of the liquid to airborne contamination. Man hours saved will pay for it many times over. Available also motor driven.

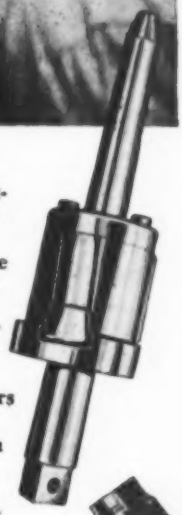
Ask for Bulletin 1226. 515

SARCO SAVES STEAM

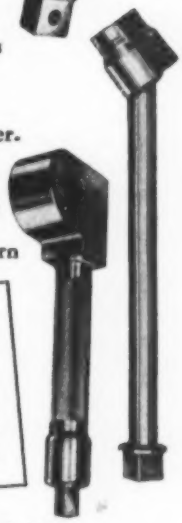
SARCO COMPANY, INC.
Empire State Bldg., New York 1, N.Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

HOW TO ROLL BOILER TUBES

You can count on smooth, efficient rolling action, which assures firm seating of the tube from precision-made Wilson Tube Expanders. They provide perfectly rolled joints, reduce time wasting re-rolling and re-inspection.



Wilson Model 38 Tube Expander— Popular, parallel, expansion flaring and rolling tool for high pressure boiler tubes, superheaters, economizers and marine steam generators. They do both rolling and flaring in a single operation . . . are available for tubes 1" OD to 4½" OD with various rolled lengths for tube sheets a half inch and up in thickness. Write for Bulletin 380A.



Wilson Accessories — Various boiler maker accessories are in stock such as right angle worm drives, gear trains, extensions, universal joints in standard size squares, etc. Look to Wilson for a complete line of modern expander tools.

Wilson Tube Cleaners make short work of the toughest deposits. Driven by air, water, steam or electricity, these high speed tube cleaners can be furnished in straight or curved, ferrous or non-ferrous from 3/8" to largest ever cleaned. Write for Bulletin 47A.

Representatives in all principal cities

THOMAS C. WILSON, INC.

21-11 44th AVENUE, LONG ISLAND CITY, L. I., N.Y.

Cable address: "Tubeclean" New York

WILSON TW-889

TUBE CLEANERS • TUBE EXPANDERS

5 Reasons
STRONG* 70 Series Traps
give better service!

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68-Q describes these traps in detail along with other STRONG traps. Write today.

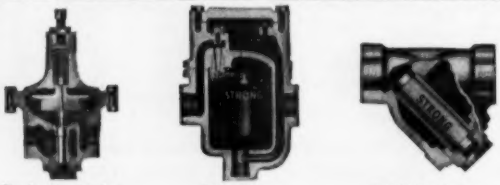
*Trademark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve | Blast Trap | "SY" Strainer

STRONG

spot news

(Continued from page 88)

power into electric motors for a given size and space.

"Complete data on derivatives, types of mountings, etc., are now available as a result of the Section's approval of its committee work", according to C. O. Hedges, chairman of the NEMA Motor and Generator Section. "Frame assignments have been made to cover the 2- through 12-pole speed ratings for the open and totally-enclosed fan-cooled types." (Also see I & P — June '53 p 75).

Tests Show Sealed Dry Type Transformers Are Safe

Extensive tests of sealed dry type transformers have proved that they present practically no danger of fire, according to E. W. Tipton of Westinghouse Electric Corp. In a report to engineers attending the Summer General Meeting of the American Society of Electrical Engineers, Tipton told of extensive tests conducted "to determine to what extent gross mistreatment of sealed dry type transformers with Class H insulation might be expected to involve fire or explosion hazards."

Until a few years ago, almost all transformers for ratings of more than a fraction of one kva were immersed in mineral oil, and were located out of doors, he said. However, development of the dry type, using inorganic material almost entirely, has changed the picture and permitted use of transformers in restricted and hazardous locations. Only in the absence of overload protection of any kind, with continued operation at high overloads, is it possible to ignite and burn the small amount of organic bonding material used in the dry type, he said, and even then the fires are of low intensity and easily extinguished. "Millions of kva of installed capacity in transformers of this type are in operation with, so far as known, a perfect record in regard to human safety."

Company Forms New Division To Identify Atomic Activities

To give separate identity to an activity in which Combustion Engineering, Inc. has been engaged for some time, and to facilitate its expansion, the company reports the formation of a Nuclear Power Division. Combustion Engineering is presently occupied with several projects having to do with the development of equipment for nuclear power generation. These include supplying of major components for an atomic-powered submarine, and conducting studies and development work having to do with practical problems of design, fabrication, and metallurgy involved in utilizing the heat generated in nuclear reactors for production of electrical power.

Heading the new division will be D. M. Schoenfeld. An executive of the company's engineering department for some years past, Schoenfeld has been in charge of engineering relative to controlled circulation boilers and marine boilers, as well as of special development in these and other fields.

—End

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

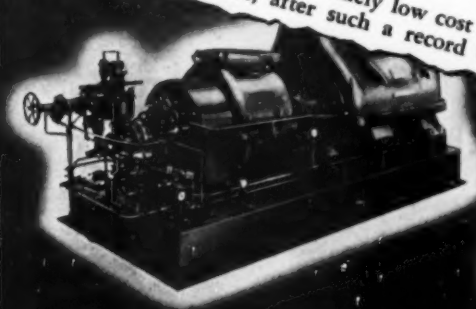
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

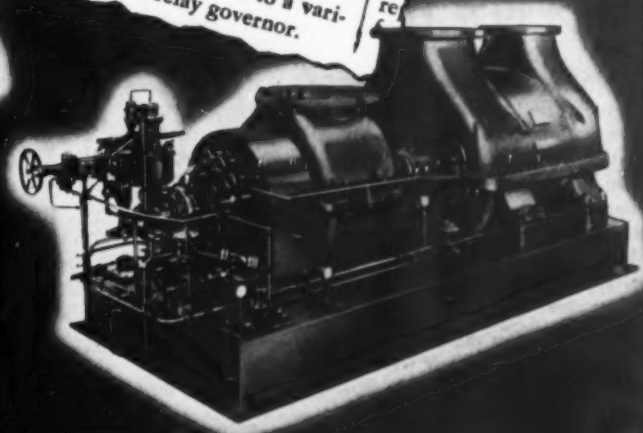
Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.





For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1193

U.S. TOTALLY-ENCLOSED Explosion-Proof MOTORS

SAFE *for dangerous damp and dusty locations*

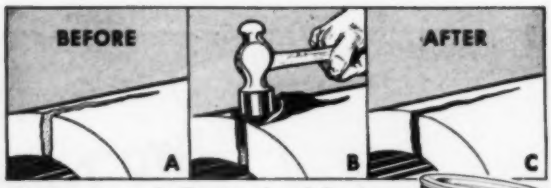
Class I—Group D

Class II—Groups F-G with or without fan

Request Bulletin

U.S. ELECTRICAL MOTORS, Inc.

BOX 2058, LOS ANGELES 54, CALIFORNIA MILFORD, CONN.



A—Deep crack. B—Tamping Smooth-On in. C—Crack completely sealed.

If You've Never Used SMOOTH-ON, *read this:*

Smooth-On No. 1 Iron Cement is a metallic powder which you mix with water to the consistency of putty. You tamp it, while still soft, into a crack or hole, making sure to force it against all surfaces. With Smooth-On you don't need to use heat or special gadgets. As it hardens, it expands slightly, clinging tightly in place. The required part is ready for use as soon as Smooth-On sets hard. Keep Smooth-On handy for both emergency and routine maintenance repairs. Buy it in 7 oz., 1 lb., 5 lb., 20 lb., or 100 lb. sizes. If your supply house hasn't Smooth-On No. 1, write us.

FREE 40-PAGE REPAIR HANDBOOK

Shows many industrial and home repairs made with No. 1 and other Smooth-On Cements. Leaks stopped, cracks sealed, loose parts made tight. 140 illustrations. Drop us a line for Your free copy.

SMOOTH-ON MFG. CO., Dept. 19
570 Communipaw Ave., Jersey City 4, N. J.

Do it with **SMOOTH-ON**

THE IRON REPAIR CEMENT OF MANY USES

NEW JERSEY PROCESS PLANT SAVES NEW FEED PUMP COST

Expansion plans called for a new boiler, and the Chief Engineer thought he'd need a new feed pump too. Pumps on hand — two 10 x 6 x 10's — often needed repairs to meet existing demand. Leaking valves kept them below capacity most of the time. He tried Sims Pump Valves before the new installation was completed and found, even at slower speeds, his pumps still supplied all the water necessary. When the new boiler was put on the line, the same pumps with Sims Valves carried the load easily.

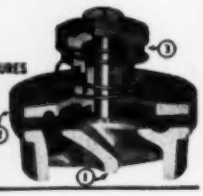
Three years later the Chief said, "Sims Valves were a good investment." They were — but he couldn't lose anyhow. Sims Valves were *guaranteed* to give him better performance — complete satisfaction.

See how Sims valves can help with your pump problems. Carried in stock to fit over 40 different makes of reciprocating pumps — and hundreds of sizes — they'll fit your pumps — improve performance. Free catalog shows how.

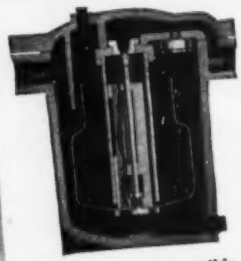
SIMS
PUMP VALVE CO. INC.
1314 PARK AVE HOBOKEN, N.J.
M & M BLDG HOUSTON, TEXAS

...Only **SIMS** HAS THESE PATENTED FEATURES

① Inclined ribs, which help increase pump capacity 20%.
② Valve disc that rotates every time it lifts.
③ Double shock-absorber stem head.



ILLINOIS Steam Trap



Simple—has only two moving parts

Valve Stem Travels Independent of Bucket— no other trap has this feature.

Instantaneous Valve Action — either wide open or tight shut — will not dribble on partial closing of valve under slow condensation rates.

Wire Drawing Impossible — valve has snap action.

Simple — moving parts are valve and bucket.

Cannot Air Bind — vents air continuously without loss of steam.

Cannot Blow Steam — always water sealed.

Surface Discharge—flushes out all grease and sludge.

Valve Seat — of special alloy, fully guaranteed.

Inspection Easy — without disturbing piping.

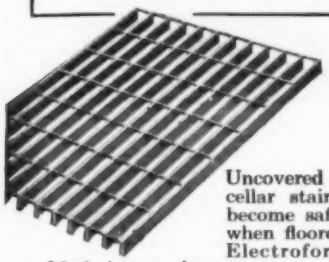
Works Equally Well on All Fluids — compressed air lines, air separators, air aftercoolers.

Write for Bulletin 35

Consult us on your requirements

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1906
RACINE AVENUE AT 21ST STREET • CHICAGO 8

Make those **OPEN SPACES**
SAFE and USABLE
with this unique, one-piece
OPEN STEEL FLOORING



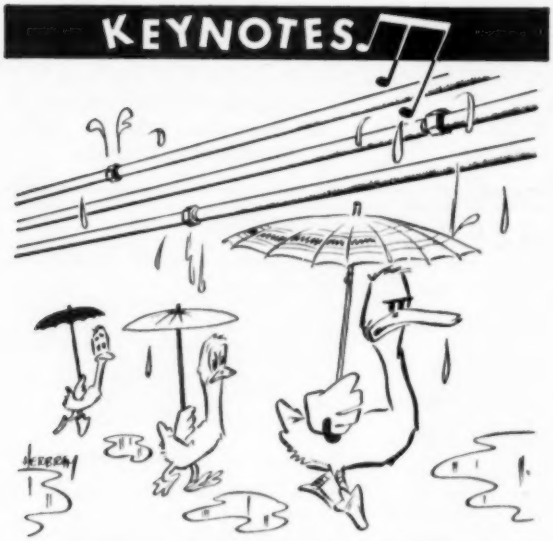
SILENT!
STRONG!
SECURE!

Uncovered pits, light wells, cellar stairways, etc. quickly become safe and usable areas when floored with Blaw-Knox Electroforged Steel Grating. Made in one piece . . . no nuts or bolts to rattle or lose. Provides safe footing even when wet or greasy and lasts indefinitely. Admits maximum light and air. Furnished in any shape, cut to fit. Just send dimensional sketch of area to be covered and we will forward price by return mail.

BLAW-KNOX COMPANY, *Grating Department*
BLAW-KNOX EQUIPMENT DIVISION
2072 Farmers Bank Building, Pittsburgh 22, Pa.

ELECTROFORGED® STEEL
BLAW-KNOX GRATING

KEYNOTES



"Somebody ought to tell them about KEY-TITE, the perfect waterproof sealer for pipe joints carrying water, gas, low-pressure steam."

Write for FREE Sample

SEALS TIGHT... BREAKS RIGHT!

A Product of KEY COMPANY
321 S. 27th St. • East St. Louis, Illinois

Put up to Stay up!

trouble free service for over 22 years...that's only one record for...

GRID UNIT HEATERS

That's the experience of a large midwest manufacturer. Twenty-two years of service without need for repairs prove to him that, with a GRID installation, first cost is last cost. Such service records (GRID installations made in 1929 are still operating) are the rule rather than the exception with GRID Unit Heaters because GRID was deliberately designed to be a better unit heater. To provide not only ample, comfortable heat, but to give years of service without the usual high maintenance cost generally experienced with ordinary unit heaters.

Such service records occur because GRID is completely different from other unit heaters — here's how:

GRID is an all cast unit with finned heating sections and headers tested to withstand steam pressures up to 250 # P.S.I.

GRID construction uses no brazed, soldered, rolled or welded connections between condenser and headers. A specially designed threaded nipple assures a precision, leak-proof fit.

GRID construction has all similar metals in contact with steam, thus preventing electrolytic corrosion which eventually occurs in copper type unit heaters where steam passes from iron pipes into copper cores. (Write for booklet CORROSION IN UNIT HEATERS.)

GRID construction resists corrosion from fumes present in most types of industry.

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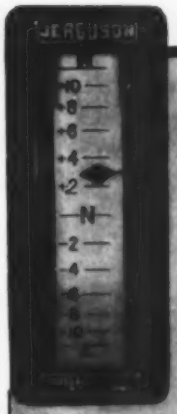

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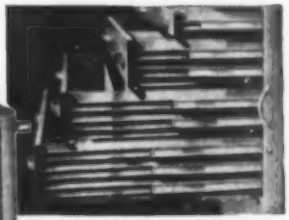
ROLL-CAB



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"rolls the shop to the job"

You'll speed up *any* maintenance job when you give a man the needed tools, plus a sturdy bench, right at arm's reach, anywhere in the plant. That's what a Snap-on Roll-Cab does. It ends those repeated trips back to the tool crib. Its reinforced steel construction (weight, 388 pounds, empty!) provides a sturdy, steady base for vises, grinders, etc. Work top is smooth, enduring masonite. Handy outlets for power tools. Full-adjustable lamp. Big, rubber-shod wheels, two swiveling. Positive foot brakes anchor the bench securely. Durable, baked-on red enamel finish. Write for new Industrial Catalog and General Catalog of 4,000 hand and bench tools. Direct Snap-on service to industry everywhere through factory branch warehouses in 42 industrial centers.

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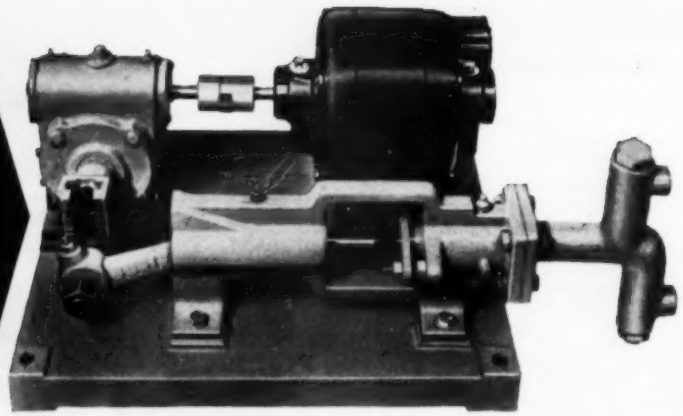
Kenosha, Wisconsin

*Snap-on is the trademark of Snap-on Tools Corporation

for water softening,
boiler treatment and
all chemical applications..
we introduce

ORCHEM
LITTLE GIANT PUMP

small . . . compact . . .
efficient . . . economical . . .



As its name implies, the *Orchem Little Giant Pump* is small and compact. But it's designed to do a *big* job, economically. It's ideal for water softening, boiler treatment and all chemical applications up to a P.S.I. of 800 lbs.

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Suction and discharge sides consist of a radically new integral double ball and seat unit—two balls and two seats—in one complete unit. Direct flow in and out assures minimum slippage. Non-air binding. Maximum displacement efficiency. Inexpensive units easily removed with large standard screwdriver.

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2340

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For Steam, Air, Gas, Water and Oil Lines. Get prices and more data on this good strainer. Write for Bulletin 184.

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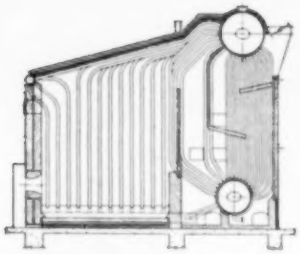
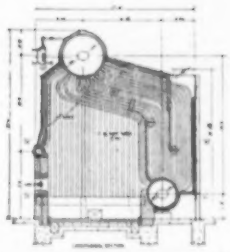


2 Drum Water Tube Boiler



Type-S 2 Drum Boiler Series S1

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STEAM GENERATORS

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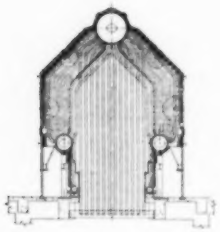
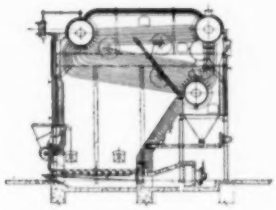
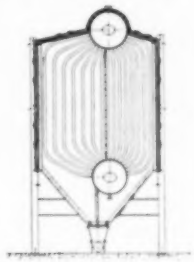


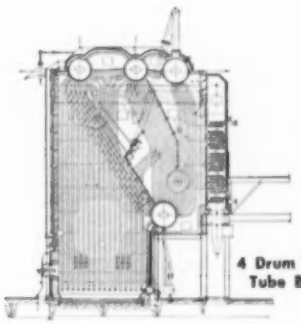
"A" Type Water Tube Boiler



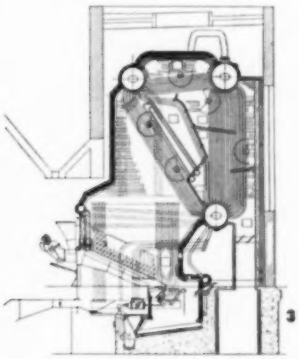
3 Drum Low Head Water Tube Boiler



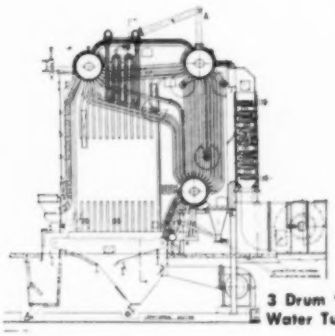
Wickes 2 Drum Waste Heat Installation



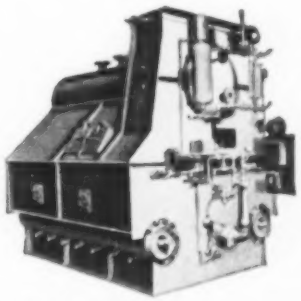
4 Drum Water Tube Boiler



3 Drum Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



Type "A" "Packaged" Steam Generator

THE WICKES BOILER COMPANY • DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

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420 Main St.
St. Joseph, Michigan
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authorized by U. S. Post Office

In every Industry...

This One STEAM TRAP

Stands Out!

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✔ **PAPER PRODUCTS** "Approx. 30 traps on wax applicators have been replaced with Super-Silvertop inverted bucket steam traps with net savings in steam of 4,000 lbs. for hour." Augusta, Ga.

✔ **FOOD** "Since trapping our kettles with Super-Silvertop Steam Traps we've had a steam savings, had no trouble with the traps, nor have we purchased repair parts." Pittsburgh, Pa.

✔ **HOSPITAL** "We use your trap altogether. We have 100 to 150 Anderson Traps in use, which we find very satisfactory and reliable." Muskogee, Okla.

✔ **DRY CLEANING** "These traps really work and do an excellent job with no care whatever." North Tonawanda, N. Y.

✔ **LAUNDRY** "The 100 Super-Silvertop Traps installed on our presses, tumblers, ironers, etc. work perfectly and are all you claim. The majority have been on line for 5 years and the saving in fuel alone has paid for them." Richmond, Va.

● **Steam Trap users in every industry compliment Super-Silvertops for their long-life, condensate-draining and air-venting ability. A masterpiece in steam trap construction, valve and seat are of a special chrome nickel alloy, developed especially for the corrosion and abrasion conditions in steam lines. The trap can be installed straight-in-line or as an elbow and can be opened for inspection without removing from the pipeline.**

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